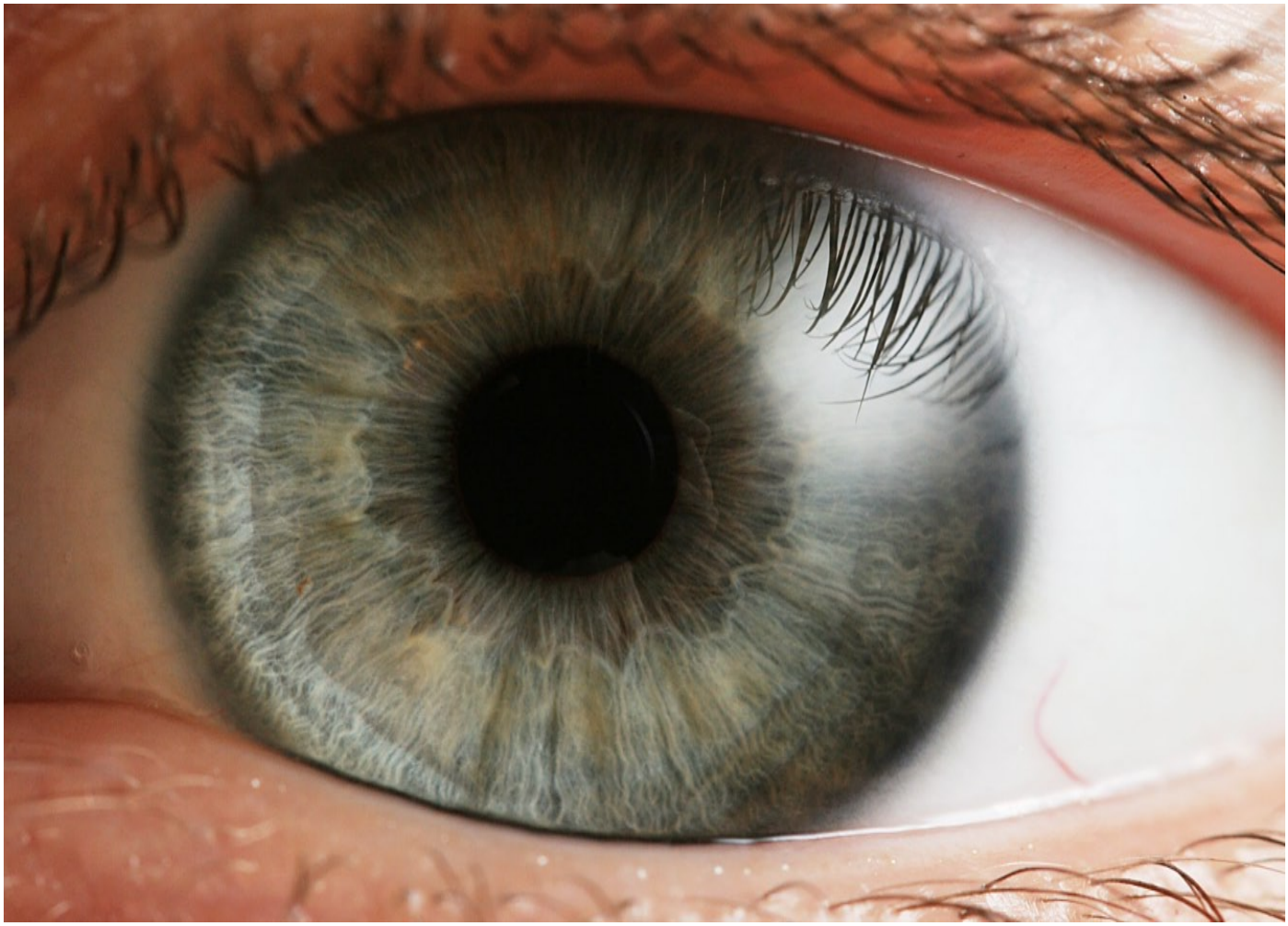
Laser Information Age

How you can educate your visual system with laser intelligence and participate in the

Emergent Open Resource Based Economy via UNESCO's Virtual University

Compiled by Carlos Concepcion



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I dedicate this book to my genuine and competent wife Patty, the Loving Mother of my Good, Beautiful and True Son William for patiently supporting my Laser Enlightened Vision, tolerating my weaknesses and providing the Stability of the Family Home that enabled me to Focus Consistently on this project for over 10 years. This work is especially dedicated to William who from the very first moment (6/22/99) that he opened his Eyes to this world and connected them to mine activated my heart and made it resonate to that filial love that was intensely radiating from his eyes. Through his Radiant new born Eyes I learned that Light embodied (absorbed, refracted and reflected) in the human being is the true source of Love that makes life worth living. It is for him and to all those pure and innocent children of his generation who will create an environmentally clean and prosperous future for the Earth and its entire population that I offer this Labor of Love in Laser Light. John Lennon's video song; Beautiful Boy captured the real meaning of my true Love.[1]

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Introduction: Emergence of the Laser Information Age with the Virtual Retinal Display, Optical Microchips, Fiber and Free Space Optics, LaserFusion and LaserDrilled Geothermal power and the Atomic Laser from the Bose-Einstein Condensate, Free MIT OpenCourseWare with UNESCO'S Virtual University and the Rise of an Open Resource Based Global Economy (ORBE) based on Libertarian Socialism

Figure 1. The Virtual Retinal Display is a laser information device that converts the human visual system into a computer monitor.[2] The VRD was designed to produce a symbiotic[3] relationship between the cognitive and emotional resources of the human brain with the social world of the internet. The VRD effectively integrates the broad bandwidth continuum of lasers on the Lambdasphere (the optical infrastructure of the internet and the universe of laser stars) with the broad bandwidth channels of the visual cortex. The VRD exemplify how Einstein's conception of the laser in 1916 became our living perception of augmented reality today. Credit: courtesy of Microvision.[4]

The Creative Commons as the Legal Foundation of the Laser Information Age

Laser Information Technology (figure 1) has revolutionized our vision of the universe as well as ourselves. The laser has coherently empowered and upgraded every health, wealth and knowledge creation industry it has penetrated since its birth in 1960. The laser effect is visible in research and development, the computer, telecommunications, energy, manufacturing, medicine, housing, entertainment, education and the internet. This Laser Information Age book emerged from my bibliographic research project into the coherent foundations of the universe, the laser emerged from this search as a solution looking for problems to solve and it has resulted in the possible solution to all our problems. The opportunities for the advancement of civilization that are available thanks to a multiplicity of laser applications are truly amazing. However, our individual and social consciousness has not captured the full spectrum knowledge value of the laser's atomic and cosmic coherence mainly because this advancement is deliberately closed or classified for military advantage or privatized for profit via trade secrets. According to Wikipedia; "Classified information is sensitive information to which access is restricted by law or regulation to particular classes of people. A formal security clearance is required to handle classified documents or access classified data. The clearance process requires a satisfactory background investigation. There are typically several levels of sensitivity, with differing clearance requirements. This sort of hierarchical system of secrecy is used by virtually every national government. The act of assigning the level of sensitivity to data is called data classification. Certain non-government organizations and corporations also have classified information, which is/are normally referred to as (a) trade secret(s)…

Declassification is the process of documents that formerly were classified becoming available to the public, under the principle of freedom of information. Procedures for declassification vary by country. Freedom of information (or information freedom) refers to the protection of the right to freedom of expression with regards to the Internet and information technology (see also, digital rights). Freedom of information may also concern censorship in an information technology context, i.e. the ability to access Web content, without censorship or restrictions. Freedom of information is an extension of freedom of speech, a fundamental human right recognized in international law, which is today understood more generally as freedom of expression in any medium, be it orally, in writing, print, through the Internet or through art forms. This means that the protection of freedom of speech as a right includes not only the content, but also the means of expression.[1] Freedom of information may also refer to the right to privacy in the context of the Internet and information technology. As with the right to freedom of expression, the right to privacy is a recognized human right and freedom of information acts as an extension to this right."[5]

For a great introduction to a citizen's privacy problem in relation to the state and the corporate privatization of information on the internet see: Blown to Bits: Your Life, Liberty, and Happiness After the Digital Explosion [ILLUSTRATED] by Hal Abelson, Ken Ledeen, Harry Lewis. Review: Every day, billions of photographs, news stories, songs, X-rays, TV shows, phone calls, and emails are being scattered around the world as sequences of zeroes and ones: bits. We can't escape this explosion of digital information and few of us want to–the benefits are too seductive. The technology has enabled unprecedented innovation, collaboration, entertainment, and democratic participation. But the same engineering marvels are shattering centuries-old assumptions about privacy, identity, free expression, and personal control as more and more details of our lives are captured as digital data. Can you control who sees all that personal information about you? Can email be truly confidential, when nothing seems to be private? Shouldn't the Internet be censored the way radio and TV are? Is it really a federal crime to download music? When you use Google or Yahoo! to search for something, how do they decide which sites to show you? Do you still have free speech in the digital world? Do you have a voice in shaping government or corporate policies about any of this? Blown to Bits offers provocative answers to these questions and tells intriguing real-life stories. This book is a wake-up call to the human consequences of the digital explosion. About the Author: Hal Abelson is Class of 1922 Professor of Electrical Engineering and Computer Science at MIT, and an IEEE Fellow. He has helped drive innovative educational technology initiatives such MIT OpenCourseWare, cofounded Creative Commons and Public Knowledge, and

was founding director of the Free Software Foundation. Ken Ledeen, Chairman/CEO of Nevo Technologies, has served on the boards of numerous technology companies. Harry Lewis, former Dean of Harvard College, is Gordon McKay Professor of Computer Science at Harvard. He is author of Excellence without a Soul: Does Liberal Education Have a Future? Together, the authors teach Quantitative Reasoning 48, an innovative Harvard course on information for non-technical, non-mathematically oriented students."[6]

As a general rule, after it declassifies the information, the US federal government grants monopoly control of those inventions that resulted from publically funded research via the Bayh-Dole Act or University and Small Business Patent Procedures Act (a legislation from 1980 freely Documented @ http://www.cogr.edu/docs/Bayh_Dole.pdf).[7] Through this Act, laser findings are appropriated (copyrighted and patented), locked up or hidden for competitive and commercial advantage by universities and their partners, the corporations. All this wheeling and dealing with the public treasury and the intellectual commonwealth occurs in the background of a state capitalist society like the US, so that it shall socialize cost, risk, debt and privatize profit. As you will clearly see throughout this book, the Bayh-Doled Act is one of the main policies that the state capitalist uses to transfer the intellectual wealth of the nation to the corporations. This tri-partnership between the government, the university and the corporations—known as the triple helix or national innovation system—is the key infrastructure used by the privatized wealth creating superpower that became the USA after WWII. We will see how MIT Open Courseware and the Free Software Foundation sparked a revolution within this infrastructure by reversing this privatization trend and democratized or socialized the transfer of the wealth creating knowledge base in section 1.3 below.

A very important study about this transfer of intellectual power is: Ivory Tower and Industrial Innovation: University-Industry Technology Transfer Before and After the Bayh-Dole Act by David Mowery, Richard Nelson, Bhaven Sampat, Arvids Ziedonis. Amazon Review "This book addresses an important and timely topic which has garnered substantial interest among policymakers, academic analysts, and the broader scientific and technical community. It reflects over a decade of careful qualitative and quantitative research by these authors. This collection brings together their most interesting work in this important area." —Scott Stern, Kellogg School of Management, Northwestern University." This clear and succinct volume convincingly overturns the conventional wisdom about university-industry relations in science and technology. The authors muster extensive historical and contemporary empirical evidence to build a robust and nuanced conception of the transfer of knowledge between the two sectors. This work warrants close attention from academic administrators, research managers, and public policy-makers in the U.S. and abroad."—David M. Hart, Kennedy School of Government, Harvard University." This splendid volume offers a nuanced and sophisticated assessment of the growing ties between universities and industry, arguing that public policy was a facilitator but not a catalyst and that university R&D faces threats from its growing proprietary emphasis. No student or analyst of the R&D process, or university administrator, should ignore the message of this book that the preeminence of U.S. universities rests upon a commitment to open science, and that it is precisely that openness that enhances industrial innovation."—Walter W. Powell, Stanford University, School of Education... Other, more critical accounts of the Bayh-Dole Act have suggested that the growth in academic patenting and licensing has changed the "research culture" of U. S. universities, leading to increased secrecy, less sharing of research results, and a shift in the focus of academic research away from fundamental to more applied topics…

Since the early 1980s, universities in the United States have greatly expanded their patenting and licensing activities. The Congressional Joint Economic Committee, among other authorities, argued that the increase in university patenting and licensing contributed to the economic boom of the 1990s. Many observers have attributed this trend to the Bayh-Dole Act of 1980, which facilitated patenting and licensing by universities. This book examines the conventional wisdom by adopting a more holistic point of view, examining the diverse channels within which commercialization has occurred throughout the 20th century and since the passage of the Act. Using quantitative analysis and detailed case studies to assess the effects of the Act, it concludes that universities must maintain their historic commitment to the free flow of knowledge to serve the global public interest and sustain their remarkable scientific and technological achievements of the past century… Congress had debated the issue of ownership of patents resulting from publicly funded research for decades before the passage of Bayh-Dole, and federal patent policy was a central point of contention during the debates of the 1940s over the organization of postwar U.S. science and technology policy. One side of the debate over patent policy was represented by Senator Harley Kilgore (D-W.Va), who argued that the federal government should retain title to patents resulting from federally funded research and place them in the public domain (Kevles, 1978). According to Kilgore, allowing private contractors to retain patents represented a "giveaway" of the fruits of taxpayer-funded research to large corporations, reinforcing the concentration of technological and economic power. The opposing position was articulated by the director of the wartime Office of Scientific Research and Development (OSRD), Vannevar Bush, who argued that allowing contractors to retain patents rights would preserve their incentives to participate in federal R&D projects and to develop commercially useful products based on government-funded research."[8]

Vannevar's proposal is outlined in his free e-book: Science: The Endless Frontier. Because of his emphasis on the privatization of science and engineering in this seminal book, he became the father of the Military industrial complex. As FDR's director of the OSRD during World War II, he was a leader of the Manhattan Project, his computer science contributions made him a pioneer of the theory of the Internet and his business sense made him a founder of the Raytheon Company (a leading military contractor). Vannevar was the key player for the establishment of the model that transfers the resources of the civilian scientific community to the needs of an ever-hungry military financed by the largesse of the taxpayer. He also established the seminal ideas that became the National Science Foundation (NSF) and the National Institutes of Health (NIH), two very successful public institutions who are today unfortunately in the service of private interest. NIH disburses over 30 billion dollars a year in grants for biological R & D that is mostly converted into patents for the Pharmaceutical industry. (See: The Truth About the Drug Companies: How They Deceive Us and What to Do About It by Marcia Angell, a former New England Journal of Medicine Editor). NSF has an annual budget of about 6 Billion that it distributes for science and engineering projects around the country and it is also in the business of encouraging the conversion of science into private intellectual property for the corporations. The Microvision VRD as the keystone technology[9] of the Laser Information Age was stimulated by NSF funding and nurtured by multi-million dollar military contracts for over ten years. See the foundational ideas

in the seminal paper entitled: EC/NSF Position Paper: Toward tightly-coupled human interfaces by Dr. Thomas A. Furness III. But NSF and NIH are only a fraction of the Trillions that are appropriated or privatized via the Pentagon (See: The Three Trillion Dollar War: The True Cost of the Iraq Conflict by Nobel Economist Joseph E. Stiglitz, and Linda J. Bilmes.[10] Vannevar was a gifted MIT mathematician, engineer and professor but I think it was fundamentally wrong and immoral for him to direct the US public resources into the private military business. Our world today is paying a huge price in both blood and treasure in order to provide profit for the military corporations that he promoted. See: House of War: The Pentagon and the Disastrous Rise of American Power by James Carroll and the sobering documentary: Why We Fight. [11]

It is in Charles M Vest's recent books that I first discovered the important role of the Bayh-Dole Act, Vannevar Bush and the Triple Helix: The American Research University from World War II to World Wide Web: Governments, the Private Sector, and the Emerging Meta-University (The Clark Kerr ... the Role of Higher Education in Society) by Charles M. Vest (president of MIT, 1990-2004). Amazon Review: "Forty years after Clark Kerr coined the term multiversity, the American research university has continued to evolve into a complex force for social and economic good. This volume provides a unique opportunity to explore the current state of the research university system. Charles M. Vest, one of the leading advocates for autonomy for American higher education, offers a multifaceted view of the university at the beginning of a new century. With a complex mission and funding structure, the university finds its international openness challenged by new security concerns and its ability to contribute to worldwide opportunity through sharing and collaboration dramatically expanded by the Internet. In particular, Vest addresses the need to nurture broad access to our universities and stay true to the fundamental mission of creating opportunity. About the Author: Charles M. Vest is President Emeritus and Professor of Mechanical Engineering at the Massachusetts Institute of Technology. He is author of Pursuing the Endless Frontier: Essays on MIT and the Role of Research Universities and Holographic Interferometry."

Figure 2. MIT's Great Dome and Killian Court in Cambridge, Massachusetts, USA. Motto: Mens et Manus or Mind and Hand [1] Credit: courtesy of Wikipedia.

A more in-depth review of: The American Research University is given by Lara K. Couturier @ Google Scholar: "As president of the Massachusetts Institute of Technology (MIT), Charles Vest publicly acknowledged MIT's history of gender discrimination in the sciences and supported reforms to correct it. He fought the Justice Department's challenge to the Overlap Group's joint agreement to avoid bidding wars for students by offering uniform need-based financial aid awards. When many other universities were jumping into for-profit online learning, Vest championed the MIT faculty's vision of offering course materials around the world for free through the OpenCourseWare (OCW) initiative… Another nice feature of this book is Vest's personal recounting of the development of MIT's OpenCourseWare, which he describes as "an adventure because it is a free-flowing, empowering, and potentially democratizing force, so we do not know in advance the uses to which it will be put" (pp. 96–97). No doubt, higher education's exploits in online learning will be fodder for much historical writing in the future, and OpenCourseWare's unique—and free—approach will be central to those investigations. Vest hints at the richness of that story when he reveals, "In another [unnamed] country, an underground university based largely on MIT OCW educates young men and women who, because of their religion, are forbidden to attend universities" (p. 97)." [12] It is also in Professor Vest's books that I found the first practical description of how a reversal in direction of the triple helix is possible and actual for the laser in particular and for all the health, wealth and wisdom creating technologies in general. The movement from the private to the public domain or the socialization of profit and the open sharing of the intellectual resources of the

people is now truly evident. The educational and software sector of a more holistic revolution is actually happening right now over the internet, thanks in great part to the father of the Free Software Foundation, Richard Stallman who established it in the 1980's at the MIT AI Lab and to the more recent MIT OpenCourseWare initiative.

"The MIT OCW is a free publication of course materials used at MIT. You get lecture notes, problem sets, labs and more. You can watch lecture videos and demonstrations. Access the entire curriculum for any of their five colleges and its 1800 courses, no registration required."[13] Wikipedia gives us a brief but very accurate account of MIT history. "The Massachusetts Institute of Technology (MIT) is a private university located in Cambridge, Massachusetts. MIT has five schools and one college, containing 32 academic departments,[2] with a strong emphasis on scientific and technological research. MIT is one of two private land-grant universities and is also a sea grant and space grant university. MIT was founded by William Barton Rogers in 1861 in response to the increasing industrialization of the United States. Although based upon German and French polytechnic models of an institute of technology, MIT's founding philosophy of "learning by doing" made it an early pioneer in the use of laboratory instruction[3] undergraduate research, and progressive architectural styles. As a federally funded research and development center during World War II, MIT scientists developed defense-related technologies that would later become integral to computers, radar, and inertial guidance. After the war, MIT's reputation expanded beyond its core competencies in science and engineering into the social sciences including economics, linguistics, political science, and management."[14]

OCW History according to Wikipedia:

"The concept for MIT OpenCourseWare grew out of the MIT Council on Education Technology, which was charged by MIT provost Robert Brown in 1999 with determining how MIT should position itself in the distance learning/e-learning environment. The MIT OpenCourseWare was then initiated to provide a new model for the dissemination of knowledge and collaboration among scholars around the world, and contributes to the "shared intellectual commons"[15] in academia, which fosters collaboration across MIT and among other scholars. The project was spearheaded by Hal Abelson and other MIT Faculty.[16] The main challenge in implementing the OCW initiative had not been faculty resistance, but rather, the logistical challenges presented by determining ownership and obtaining publication permission for the massive amount of intellectual property items that are embedded in the course materials of MIT's faculty, in addition to the time and technical effort required to convert the educational materials to an online format. Copyright in MIT OpenCourseWare material remains with MIT, members of its faculty, or its students.

In September 2002, the MIT OpenCourseWare proof-of-concept pilot site opened to the public, offering 32 courses. In September 2003, MIT OpenCourseWare published its 500th course, including some courses with complete streaming video lectures. By September 2004, 900 MIT courses were available online. The response from MIT faculty and students has been very positive and MIT OpenCourseWare is seen as being consistent with MIT's mission (to advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the nation and the world in the 21st century) and is true to MIT's values of excellence, innovation, and leadership. In 2005, MIT OpenCourseWare and other leading open educational resources projects formed the OpenCourseWare Consortium, which seeks to extend the reach and impact of open course materials, foster new open course materials and develop sustainable models for open course material publication.

Technology

The William and Flora Hewlett Foundation and the Andrew W. Mellon Foundation also supported Utah State University's Center for Open and Sustainable Learning in the development of eduCommons, open source software that allows any organization to develop and manage their own open educational resources. Video content for the courses are primarily in RealMedia format. Though the default videos provided are meant to be streamed from the MIT server, they are also provided in full for offline downloads.

Implications

By making their educational materials openly available, it remains to be seen whether MIT can demonstrate that by giving away such materials it does not threaten the value of an MIT education, or that there may be something in the educational process that cannot be captured by being in class. However, MIT's former president Charles Vest stated that the open course material could improve teaching methods, regardless. As stated on the website, OCW does not grant degrees or certificates, does not provide access to MIT faculty or materials, and may not reflect the entire content of a course."[17]

The ultimate goal of the Laser Information Age book is to guide, prepare and provide you with access to a radiant career in or with lasers via MIT OCW or UNESCO's Virtual University open educational resources (figure 3). In order to accomplish this successfully I recommend you start your MIT career with "Home > Courses > Materials Science and Engineering > Information Exploration: Becoming a Savvy Scholar. 3.093 This freshman course explores the scientific publication cycle, primary vs. secondary sources, and online and in-print bibliographic databases; how to search, find, evaluate, and cite information; indexing and abstracting; using special resources (e.g. patents) and "grey literature" (e.g. technical reports and conference proceedings); conducting Web searches; and constructing literature reviews."[18] MIT's method of research is a good starter; you will however need to quickly update this approach with the Science Commons method described below. One of the most important statements of purpose underwriting MIT's OCW initiative is the politics of intellectual property which is the legal foundation for the laser information age. The future of democracy, education and our health, wealth and wisdom are deeply dependent on the proper establishment of the "Intellectual

Commons".[19] The survival of our species will ultimately depend on this open or transparent and fair course of action. As my favorite and most responsible MIT professor, Noam Chomsky has so aptly stated in his profound moral calling for justice and truth on: Hegemony or Survival: America's quest for global dominance and Failed States: The Abuse of Power and the Assault on Democracy (see the American Empire Project and Chomsky.info)[20]

A review by Wikipedia: "Hegemony or Survival: America's Quest for Global Dominance, published November 2003, is a book by Noam Chomsky that documents a macroscopic view of United States foreign policy from World War II to the post-Iraq War reconstruction. The central focus of the book (as with many of Chomsky's political works), is the examination of the United States' political, military and economic motives, in comparison —often in sharp contrast— to its outward rhetorical support for democracy, the Middle-East peace process, free trade, and human rights. There is an examination of the differences between positions taken by the US government and the people of the world regarding a proposed invasion of Iraq. It also examines the doctrinal thinking of the Establishment in the United Kingdom and the US, such as in regard to propaganda use, centralized decision making and imperialism of Western powers from recent American invasions to the European empires.[1]The book was recommended by Venezuelan President Hugo Chávez in a speech before the UN General Assembly in September 2006. Sales of the book surged after the recommendation, its rank on Amazon.com rising to #1 on paperback and #6 hardcover in only a few days.[2][3][4]. Failed States: The Abuse of Power and the Assault on Democracy is a book by Noam Chomsky, first published in 2006, in which Chomsky argues that the United States is becoming a "failed state," and thus a danger to its own people and the world. The first chapter, titled "Stark, Dreadful, Inescapable" alluding to the famous Russell-Einstein Manifesto, first argues that the US foreign and military policies after the Cold War greatly aggravated the danger of a nuclear war. Chomsky then recounts various facts about the war on Iraq and argues the United States specifically sought regime change, rather than the stated destruction of Iraq's WMD program." There are many other important issues that he shines a coherent light on as well, such as the democratic deficit in the US institutions or the discrepancy between public opinion and public policy. He gives the true reason for the growth of inequality and the deliberate destruction of public education.

It is very significant that MIT, who is the major recipient of R & D dollars from the Pentagon—headquarter for the US Department of Defense—now [21] sees itself as "Unlocking Knowledge and Empowering Minds."[22] For most of the post-world war II period MIT served predominantly as a private knowledge factory for the Military industrial complex and the corporations. See: The Complex: How the Military Invades Our Everyday Lives by Nick Turse. This is a genuine revolutionary act for MIT since it is through the Bayh-Dole Act that lasers are in most cases—except for the ones invented and that remains in the National Laboratories or in public schools —confiscated by corporations with the complicity of the Universities. Professor Michael Perelman (economics, California State Univ.) also makes a strong case for a reversal of the triple helix by returning the privatized intellectual property back to the public domain. This revolutionary act will unlock the intellectual commonwealth that is appropriated and deliver it back to all the people. In his powerful book: Steal This Idea, Intellectual Property Rights and the Corporate Confiscation of Creativity he said; "Imagine being arrested for patenting your own idea or for planting seeds that you saved from the previous harvest. Imagine having to pay nearly half a million dollars a year for life-saving drugs discovered by government scientist but removed from the public domain by an opportunistic biotechnology firm. Not only are these scenarios legal under our current regime of intellectual property rights, but they actually happened. Do ideas, information, and art really need to be free? Does our copyright and patent system stifle innovation? The answer to both questions is yes, says well-known economist Michael Perelman in this provocative book that unmasks our system of intellectual rights. By shielding inventions and intellectual work from dangerous competition, these rights supposedly encourage creativity. In reality, Perelman shows convincingly that current laws actually throttle innovation and progress. Intellectual property grants enormous powers to corporations but offer very little to the creative artist or inventor. By promoting fragmentation, unnecessary duplication, secrecy and frequent litigation, Perelman shows how current intellectual property rights do more damage than good. Steal This Idea, explores options for moving beyond the current regime to one that fosters intellectual progress and results in a more equitable distribution of goods under its watch." [23]

The best option for humanity today is clearly discussed in: The Public Domain: Enclosing the Commons of the Mind by James Boyle@ http://www.thepublicdomain.org/. Review "Boyle has been the godfather of the Free Culture Movement since his extraordinary book, Shamans, Software, and Spleens set the framework for the field a decade ago. In this beautifully written and subtly argued book, Boyle has succeeded in resetting that framework, and beginning the work in the next stage of this field. The Public Domain is absolutely crucial to understanding where the debate has been, and where it will go. And Boyle's work continues to be at the center of that debate."-Lawrence Lessig, C. Wendell and Edith M. Carlsmith Professor of Law, Stanford Law School and author of Free Culture@ http://lessig.org/. "In this delightful volume, Professor Boyle gives the reader a masterful tour of the intellectual property wars, the fight over who will control the information age, pointing the way toward the promise-and peril-of the future. A must read for both beginner and expert alike!"-Jimmy Wales, founder, Wikipedia. "Boyle is one of the world's major thinkers on the centrality of the public domain to the production of knowledge and culture. He offers a comprehensive and biting critique of where our copyright and patent policy has gone, and prescriptions for how we can begin to rebalance our law and practice. It is the first book I would give to anyone who wants to understand the causes, consequences, and solutions in the debates over copyrights, patents, and the public domain of the past decade and a half."-Yochai Benkler, Berkman Professor of Entrepreneurial Legal Studies, Harvard Law School and author of: The Wealth of Networks@ http://cyber.law.harvard.edu/wealth_of_networks/Main_Page.

In this enlightening book James Boyle describes what he calls the range wars of the information age—today's heated battles over intellectual property. Boyle argues that just as every informed citizen needs to know at least something about the environment or civil rights, every citizen should also understand intellectual property law. Why? Because intellectual property rights mark out the ground rules of the information society, and today's policies are unbalanced, unsupported by evidence, and often detrimental to cultural access, free speech, digital creativity, and scientific innovation. Boyle identifies as a major problem the widespread failure to understand the importance of the public domain—the realm of material that everyone is free to use and share without permission or fee. The public domain is as vital to innovation and culture as the realm of material protected by intellectual property rights, he

asserts, and he calls for a movement akin to the environmental movement to preserve it. With a clear analysis of issues ranging from Jefferson's philosophy of innovation to musical sampling, synthetic biology and Internet file sharing; this timely book brings a positive new perspective to important cultural and legal debates. If we continue to enclose the "commons of the mind," Boyle argues, we will all be the poorer."[24]

Another very lucid study of how intellectual property policy has been used historically by the rich countries to enrich themselves and turned it against the developing nations is: Bad Samaritans: The Myth of Free Trade and the Secret History of Capitalism by Ha-Joon Chang. (December 26, 2007). An Amazon reviewer gives us a glimpse of how Chang tackles the issue. "Still another Chang insight is his pointing out that pursuit of copyrights and patents are simply a sophisticated form of protectionism that again works against third-world nations by preventing their starting important new industries (e.g. Drug manufacture) that boost not only their economy but citizens' health as well. (97% of all patents and the vast majority of copyrights are held by rich countries - these are also a special problem for poor countries wanting textbooks. IMF (International Monetary Fund) also insists on enforcement mechanisms, further adding costs to poor nations. Chang sees the U.S. as the worst offender in this area. Chang asserts that self-development of new technology is difficult in third-world nations, using North and South Korea as examples. North Korea has tried to be self-sufficient (and done poorly), while South Korea has assiduously copied wherever possible and is now an industrial powerhouse." [25]

There is a great article at http://www.zmag.org/ that places the US state capitalist world system into holistic perspective: Four Crises of the Contemporary World Capitalist System, October 15, 2008 by William Tabb. "In my remarks I have stressed four areas of crisis of the contemporary world system: the financial crisis, the loss of relative power by the United States, the rise of other centers of accumulation, and resource depletion and ecological crisis. The U.S. strategy remains to project military power to control oil and other resources. The other wing of the eagle is relying on appropriation of surplus through financial vehicles, but this hardly exhausts its tactics. It also demands the enforcement of protected monopoly rents by international patent and licensing regimes to protect intangible property rights, from Microsoft Windows to Big Pharma claiming ownership of the human genome. The extension of property rights and the enclosing of the scientific commons[26] need to be (and are being) opposed by developing countries, which pay exorbitant licensing fees and are not allowed to use what in the past would be common knowledge inheritance."[27] At MIT a Science Commons initiative was also implemented in 2005 to remedy this growing global problem. I created the Laser Information Age book and made it freely available @ LaserEdu.org and the knowledge WEB precisely with the idea of reversing those selfish policies and to encourage you to participate and help integrate the power of the laser into this new networked science model. See: Science Commons @ http://sciencecommons.org/.

"Building on the Creative Commons model to Further Scientific Success
Science Commons was launched with the goal of bringing the openness and sharing that have made Creative Commons licenses a success in the arts and cultural fields to the world of science.

Science Commons designs strategies and tools for faster, more efficient Web-enabled scientific research

- Primary Focus: A PROJECT OF creative commons **Share, Remix, Reuse — Legally**

Creative Commons provides free tools that let authors, scientists, artists, and educators easily mark their creative work with the freedoms they want it to carry. You can use CC to change your copyright terms from "All Rights Reserved" to "Some Rights Reserved."We're a nonprofit organization. Everything we do — including the software we create — is free @ http://creativecommons.org/.

• **Making scientific research "re-useful"** — We develop and promote policy and tools to help people and organizations open and mark their research and data sets for reuse. As part of this work, we released an "open data" protocol to enable the global scientific community to pool and use data created under different legal regimes.
• **Enabling "one-click" access to research tools** — We offer a suite of standardized contracts to bring the efficiencies and economies of scale from e-commerce to the world of scientific tools, so researchers can easily replicate, verify, and extend research.
•**Integrating fragmented information sources** — We help researchers find, analyze, and use data from disparate sources by marking and integrating the information with a common, computer-readable language.

- Programs:

• **Scholars Copyright Program**, through which Science Commons offers a spectrum of tools and resources catering to both methods of achieving Open Access.
• **Biological Materials Transfer Project**, through which Science Commons develops and deploys standard, modular contracts to lower the costs of transferring physical biological materials such as DNA, cell lines, model animals, antibodies, and plasmids.
• **Neurocommons**, through which Science Commons is creating an open source knowledge management platform for neurological research.

• **HealthCommons**, which is a coalition of parties interested in changing the way basic science is translated into the understanding and improvement of human health.

- Corporate Structure:

• Science Commons is one of four semi-autonomous programs operated by or through Creative Commons, a Massachusetts-chartered 501 (c) (3) tax-exempt organization.

- Science Commons is overseen by members of the Creative Commons board, including MIT computer science professor Hal Abelson; intellectual property experts James Boyle, Michael Carroll and Lawrence Lessig; and lawyer and documentary filmmaker Eric Saltzman.
- Bioinformatics entrepreneur and metadata expert John Wilbanks directs the Science Commons project as Vice President for Science at Creative Commons.
- We are guided in our work by a remarkable Scientific Advisory Board, including 2002 Nobel Laureate Sir John Sulston; renowned genomics and bioinformatics scientist Michael Eisen; prominent economist Paul David; and the distinguished patent law and biotech scholar, Arti Rai. The late Joshua Lederberg (1958 Nobel Laureate) served as an Advisory Board member from 2006 until early 2008.

•The other programs include:

• **Creative Commons**, which is devoted to expanding the range of creative works available for others to legally build upon and share.
• **Creative Commons International (CCi)**, which works to "port" the core Creative Commons Licenses to different copyright legislations around the world. To date, the licenses have been ported into 45 jurisdictions.
• **ccLearn**, which has as its mission to minimize barriers to sharing and reuse of educational materials.

- Science Commons began operations in 2005

• Science Commons is housed at and receives generous support from the Massachusetts Institute of Technology, where we share space, staff and inspiration with the Computer Science and Artificial Intelligence Laboratory.
o Science Commons has an annual budget of approximately $750,000

- Operational support is raised from a variety of sources including private foundations, corporations and contracts
- Current funders include the Ewing Marion Kauffman Foundation, the John D. and Catherine T. MacArthur Foundation, the Omidyar Network and the HighQ Foundation.
- Science Commons pays approximately $40,000 in operational support fees to Creative Commons each quarter

About Science Commons

Copyright law and the Web

Copyright law allows for "all rights reserved" the minute a document is created - whether a song, a Web page, a picture - until the end of the author's life plus 70 years. On the Web that is a very long time. Seventy years ago,Life magazine was launched. In science it's even more dramatic; 70 years ago, we didn't know that DNA stored genetic informantion.

Science Commons is overseen by members of the Creative Commons board, including MIT computer science professor Hal Abelson; intellectual property experts James Boyle, Michael Carroll and Lawrence Lessig; and lawyer and documentary filmmaker Eric Saltzman. Bioinformatics entrepeneur and metadata expert John Wilbanks is Vice President.

We are guided in our work by a remarkable Scientific Advisory Board, including 2002 Nobel Laureate Sir John Sulston; the late Joshua Lederberg (1958 Nobel Laureate); renowned genomics and bioinformatics scientist Michael Eisen; prominent economist Paul David; and the distinguished patent law and biotech scholar, Arti Rai.

Science Commons is housed at and receives generous support from the Massachusetts Institute of Technology, where we share space, staff and inspiration with the Computer Science and Artificial Intelligence Laboratory.

An Introduction to Science Commons by John Wilbanks and James Boyle, August 2006 [PDF]

The spirit of sharing

"Shortly after a large-scale clinical trial in 1955, the first inactivated polio vaccine was being injected into tens of millions of people around the world - possibly the most successful pharmaceutical product launch in history. Asked why he had not obtained a patent on the phenomenally successful vaccine, Jonas Salk reportedly replied, 'That would be like patenting the sun.' A few decades later, this view seemed laughably quaint."

Alan Dove, When science rides the MTA, J. Clin Invest. 110:425-427 (2002)

(For even more information on our history and organizational structure, click here.)

There are petabytes of research data being produced in laboratories around the world, but the best web search tools available can't help us make sense of it. Why? Because more stands between basic research and meaningful discovery than the problem of search.

Many scientists today work in relative isolation, left to follow blind alleys and duplicate existing research. Data are balkanized — trapped behind firewalls, locked up by contracts or lost in databases that can't be accessed or integrated. Materials are hard to get — universities are overwhelmed with transfer requests that ought to be routine, while grant cycles pass and windows of opportunity close. It's not uncommon for research sponsors to invest hundreds of millions of dollars in critically important efforts like drug discovery, only to see them fail.

The consequences in many cases are no less than tragic. The time it takes to go from identifying a gene to developing a drug currently stands at 17 years — forever, for people suffering from disease.

Science Commons has three interlocking initiatives designed to accelerate the research cycle — the continuous production and reuse of knowledge that is at the heart of the scientific method. Together, they form the building blocks of a new collaborative infrastructure to make scientific discovery easier by design.

Making scientific research "re-useful" — We help people and organizations open and mark their research and data for reuse. Learn more.

Enabling "one-click" access to research materials — We help streamline the materials-transfer process so researchers can easily replicate, verify and extend research. Learn more.

Integrating fragmented information sources — We help researchers find, analyze and use data from disparate sources by marking and integrating the information with a common, computer-readable language. Learn more.

Science Commons in action

We implement all three elements of our approach in the NeuroCommons, our "proof-of-concept" project within the field of neuroscience. The NeuroCommons is a beta open source knowledge management system for biomedical research that anyone can use, and anyone can build on.

Towards a Science Commons

Nature quote

"- but there are also huge amounts of data that do not need to be kept behind walls. And few organizations seem to be aware that by making their data available under a Creative Commons license ... they can stipulate both rights and credits for the reuse of data, while allowing its uninterrupted access by machines."

Nature vol 438 December 2005

A brief history of why Creative Commons launched the Science Commons project.

The sciences depend on access to and use of factual data. Powered by developments in electronic storage and computational capability, scientific inquiry is becoming more data-intensive in almost every discipline. Whether the field is meteorology, genomics, medicine or high-energy physics, research depends on the availability of multiple databases, from multiple public and private sources, and their openness to easy recombination, search and processing.

Traditions in intellectual property

In the United States, this process has traditionally been supported by a series of policies, laws and practices that were largely invisible even to those who worked in the sciences themselves.

First, US intellectual property law (and, until recently, the law of most developed countries) did not allow for intellectual property protection of "raw facts." One could patent the mousetrap, not the data on the behavior of mice, or the tensile strength of steel. A scientific article could be copyrighted; the data on which it rested could not. Commercial proprietary ownership was to be limited to a stage close to the point where a finished product entered the marketplace. The data upstream remained free for all the world to use.

Second, US law mandated that even those federal government works that could be copyrighted, fell immediately into the public domain — a provision of great importance given the massive governmental involvement in scientific research. More broadly, the practice in federally funded scientific research was to encourage the widespread dissemination of data at or below cost, in the belief that, like the interstate system, this provision of a public good would yield incalculable economic benefits.

Third, in the sciences themselves, and particularly at universities, a strong sociological tradition — sometimes called the Mertonian tradition[28] of open science — discouraged the proprietary exploitation of data (as opposed to inventions derived from data) and required as a condition of publication the availability of the datasets on which the work was based.

Innovation in technology and legal friction

Each of these three central tenets evolved from concepts that existed even before the industrial revolution — at the innately slow rate of change of the legal system. Similarly, scientific publication has a long-standing tradition. Modern technologies, especially the evolving use of the World Wide Web as a library, have forever changed the mechanisms for delivery and replication of documents. In many fields, results are published nearly as quickly as they are discovered. But copyright law has evolved at a different rate. Progress in modern technology, combined with a legal system that was crafted for the analog era, is now having unintended consequences. One of these is a kind of legal "friction" that hinders the reuse of knowledge and slows innovation.

To counterbalance, a large and vibrant global community has formed to support open access for scientific literature — that is, making it "digital, online, free of charge, and free of most copyright and licensing restrictions." Major research foundations, such the Wellcome Trust and the Howard Hughes Medical Institute, have adopted groundbreaking policies to require open access to research results. The US National Institutes of Health now requires open access to funded research. Faculty at educational institutions are passing their own resolutions to ensure that their work is published openly. And most major journals have granted authors the right to self-publish versions of their peer-reviewed papers.

Yet in many cases the legal questions remain unsettled. How can we facilitate reuse of research while ensuring that authors and publishers retain attribution? What's the best way to enable the integration of data collected under different jurisdictions? What kind of legal and policy infrastructure do we need to ease the transfer of materials necessary for verifying results and extending research?

The different rates of change between modern technology and the law create friction in other places as well. For example, in the genetic realm, patent law has moved perilously close to being an intellectual property right over raw facts — the Cs, Gs As and Ts of a particular gene sequence. In other areas, complex contracts of adhesion create de facto intellectual property rights over databases, complete with "reach through agreements" and multiple limitations on use. Legislatively, the EU has adopted a "database right" that does, in fact, accord intellectual property protection to facts. This changes one of the most fundamental premises of intellectual property: that one could never own facts, or ideas, only the inventions or expressions yielded by their intersection.

The federal government's role is also changing. Under the important, and in many ways admirable, Bayh-Dole statute, researchers using federal funds are encouraged to explore commercial use of their research. Universities have become partners in developing and reaping the fruits of research. This process has yielded amazing results, converting raw, basic science into useful products in many industries. But in some cases the quest to commercialize has moved upstream, to the fundamental levels of research and data, and that has created complex legal requirements. The legal issues may be complicated when the intellectual property is a novel "method" for assaying biological activity, but there are even more questions about patents covering the genes, proteins and their inferred functions.

The sheer cost of legal work can take research "out of play" — simply because it can be more expensive to do the lawyer work than the product might reap on the open markets. This stifles scientific innovation, as the value of scientific information increases exponentially when it is connected with other scientific information, and is of the least possible value when segregated by law.

The search for a solution

These facts have not gone unnoticed. Numerous scientists have pointed out the irony that, at a time when we have the technologies to permit global access and distributed processing of scientific data, legal restrictions are making it harder to connect the dots. Learned societies such as the National Academies of Science, federal granting agencies like the National Science Foundation and other groups have all expressed concern about the trends that are developing. Any solution will need to be as complex as the problem it seeks to solve, which is to say it will be interdisciplinary, multinational and involve both public and private initiatives.

Science Commons

Science Commons applies the Creative Commons philosophy and methodology to the world of scientific research. We leverage the existing CC infrastructure: open licenses for copyrighted works, commons deeds and metadata, international affiliations and more. We also extend the infrastructure into science where appropriate — creating CC-inspired contract suites for materials like cell lines or mice, or building open source platforms for knowledge management and data visualization. Part of our role is to serve as a social engineering group for scientists, and part attorney arguing on behalf of the public domain in science. Our aim is to clear the legal and technical pathway for accelerating discovery worldwide.

Learn more about our projects to open and mark research and data for reuse, streamline and automate the materials transfer process and integrate data from disparate sources."[29]

In this book we are focused on the Zeitgeist or spirit of the Laser Information Age and its foreground technologies (laser displays) as well as its background technologies (laser fusion/fission power and geothermal sources and the fiber and free space optics infrastructure). When the foreground technology of the Virtual Retinal Display (figure 1) and its coupling to Open Educational Resources (figure 2) is applied to the grand architecture of the Open Resource Based Economy or ORBE (figure 8), the VRD emerges as the keystone technology for the visualization of the new laser information world. OER emerged from UNESCO's (United Nations Educational, Science and Cultural Organization) Virtual University (figure 3) program. VU is a practical confirmation that our higher educational institutions have taken a first step towards the realization of the ORBE. This open access economy is based on the fundamental concept of individual freedom (Libertarianism) from the monetary system (Federal Reserve System), which means in this context that free food, free housing, free transportation, free healthcare, free technology, free entertainment and free education equals a truly free society (Socialism). According to the VU document, "first, there is growth in virtual university activities, many of which allow traditional universities to expand their reach and increase the flexibility of the educational offer. Blended learning, which combines classroom and online study, offers new learning methods, while open source software and courseware facilitate sharing of resources and reduce costly duplication of effort. These changes promote a learner-centered pedagogy…

The Virtual University Models and Messages: Lessons from case studies, Susan D'Antoni, editor. Introduction: Information and Communication Technology (ICT) offers the university both an opportunity and a challenge. By using ICT the university can provide increased flexibility to students while reaching students beyond the usual catchment area. However, institutions need to develop and apply appropriate policies, and to plan and manage effectively for a new mode of teaching and learning. The virtual university warrants examination as it represents an important development in the use of ICT to increase flexibility and extend provision of higher education in both developed and developing countries. The virtual university can be seen as "a metaphor for the electronic, teaching, learning and research environment created by the convergence of several relatively new technologies including, but not restricted to, the Internet, World Wide Web, computer mediated communication ..." (Van Dusen, 1997). One of the ways of examining change in higher education is to put a number of institutions under a microscope by means of case studies, and this has proved a fruitful approach. The cases selected for study represent a range of - although not all - institutional models, and diverse - although not all - geographic regions. The task of each author was to tell the story of the institution and to illuminate the main policy, planning and management challenges, and finally, to convey a message to the reader with the lessons learned. The case studies are the heart of this publication and they were designed to speak for themselves. Taken together, the case study chapters outlined below put forward a rich and diversified description of the Virtual University. They outline the changing landscape of a global marketplace of higher education. But first, three initial chapters put in place a backdrop for the virtual university cases and their messages:

- the main trends that impinge on higher education;
- the challenges and opportunities facing the university;
- the impact of borderless education. "[30]

Figure 3. E-learning and the virtual university are examples of the use of information and communication technology (ICT) as a teaching and learning approach and an organizational structure. Both raise issues associated with the phenomenon of cross-border education. This publication explores the related ICT policy, planning and management implications of several new or reorganized institutions of higher education. Three background chapters describe the context – the trends and challenges and the impact of cross-border education. Eight case studies from different regions and representing various institutional models tell the story of their development and relate what they have learned. UNESCO leads the global Education for All movement, aiming to meet the learning needs of all children, youth and adults by 2015.WORKING FOR UNESCO MEANS: Participating in an ongoing dialogue among nations. The mission of dialogue and cooperation which UNESCO, a specialized agency of the United Nations, has been pursuing since its founding in November 1945 covers four major fields: education, science, culture and communication. Its aim: to build peace in the world through knowledge, social progress, exchange and mutual understanding among peoples. This is a mandate which is evolving with the twenty-first century. Credit Courtesy of UNESCO.ORG[31]

According to Wikipedia "Open educational resources (OER) are an Internet empowered worldwide community effort to create an education commons. The term "open educational resources" was first adopted at UNESCO's 2002 Forum on the Impact of Open Courseware for Higher Education in Developing Countries funded by the William and Flora Hewlett Foundation. Open educational resources are educational materials and resources offered freely and openly for anyone to use under the creative commons or GNU licenses to re-mix, improve and redistribute…"[32] The Creative Commons licenses enable copyright holders to grant some or all of their rights to the public while retaining others through a variety of licensing and contract schemes including dedication to the public domain or open content licensing terms. The intention is to avoid the problems current copyright laws create for the sharing of information… An example of this license is GNU (pronounced /gnu□/) which is a computer operating system composed entirely of free software. Its name is a recursive acronym for GNU's Not Unix; it was chosen because its design is Unix-like, but differs from UNIX by being free software and containing no UNIX code[2] Development of GNU was initiated by Richard Stallman and was the original focus of the Free Software Foundation (FSF)… An application of this new platform is the gNewSense. (Figure 5) This GNU/Linux distribution is an operating system designed for users who wish to only use free software on personal computers. gNewSense is based on Ubuntu (Linux-based operating system), but with all proprietary software and binary blobs removed. It is listed by the FSF as a free operating system."[2] This freedom to educate and share valuable information is truly the dawn of that Open Resource Based global Economy (ORBE) that will liberate our society and the Earth from the corruption of the Federal Reserve System and Wall street.

Figure4.The GNU project and free software movement originated at MIT AI Lab. The GNU General Public License (GNU GPL or simply GPL) is a widely used free software license, originally written by Richard Stallman for the GNU project.[33] It is the license used by the Linux kernel. The GPL is the most popular and well-known example of the type of strong copyleft license that requires derived works to be available under the same copyleft. Under this philosophy, the GPL is said to grant the recipients of a computer program the rights of the free software definition and uses copyleft to ensure the freedoms are preserved, even when the work is changed or added to. Credit: courtesy of Wikipedia [34]

History of Open educational resources

Open educational resources include:

- *Learning content:* full courses, course materials, content modules, learning objects, collections, and journals.
- *Tools:* Software to support the creation, delivery, use and improvement of open learning content including searching and organization of content, content and learning management systems, content development tools, and on-line learning communities.
- *Implementation resources:* Intellectual property licenses to promote open publishing of materials, design-principles, and localization of content.

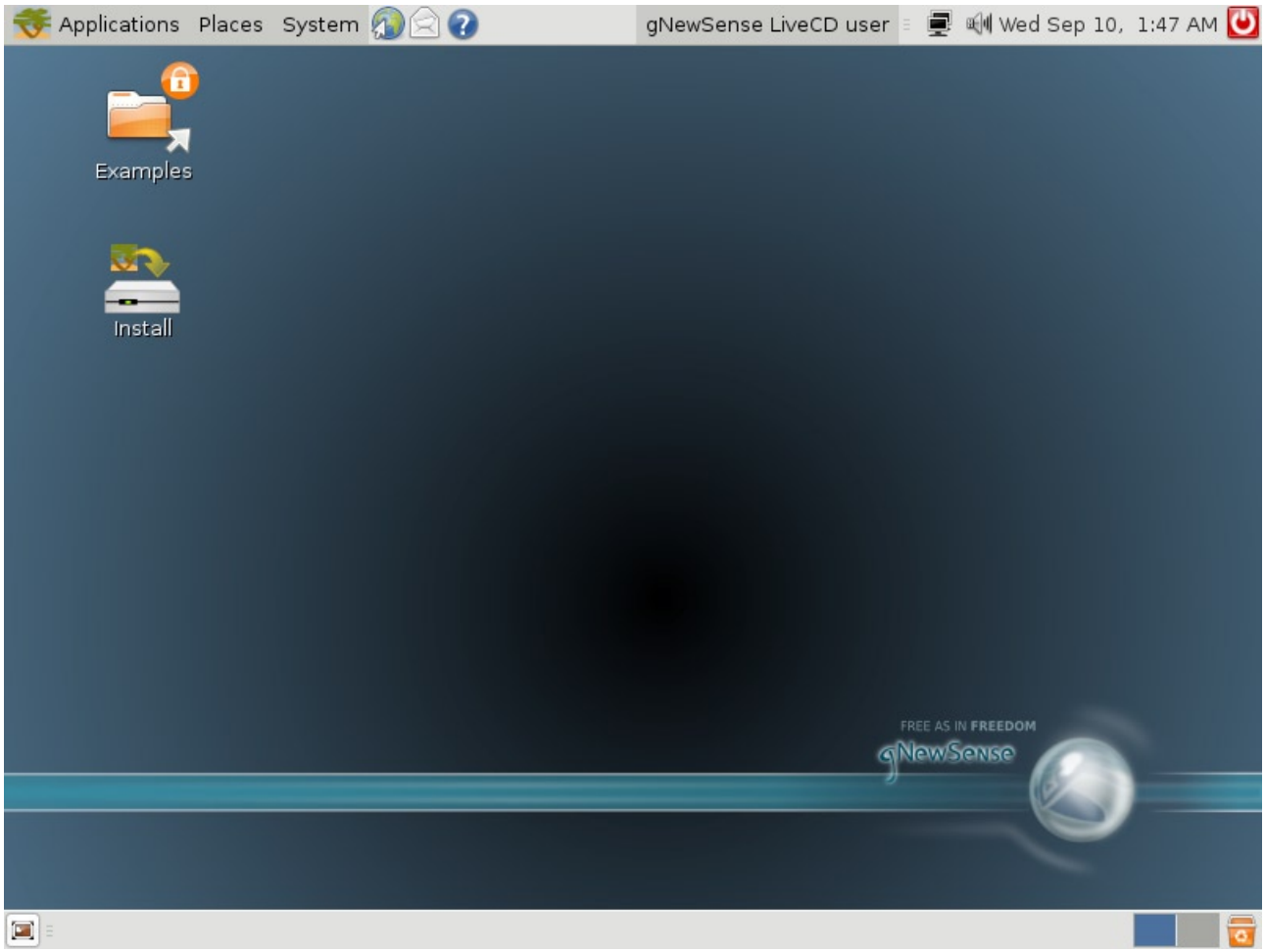

Figure 5. gNewSense takes a very strict stance for free software. For example, any documentation that gives instructions on installing non-free software is excluded [3]. The backing project was founded and launched by Brian Brazil and Paul O'Malley in 2006. In October 2006, after the 0.85 release[4] it was given assistance by the Free Software Foundation.[5] Credit: Courtesy of Wikipedia

History

In June 2007, educators at the iCommons iSummit in Dubrovnik joined the open movement worldwide to showcase emerging open education initiatives and to explore ways to better create, share and evolve open educational materials. In September 2006, the Third Annual Open Education Conference (Community, Culture and Content) was held in Logan, Utah. The last conference was held on September 24-27, 2007 in Logan, Utah. From 24 October to 2 December 2005 the UNESCO on-line Forum Open course content for higher education took place. In January 2008 The Cape Town Open Education Declaration was published. OER and Open source. Since 2005 there has been a marked increase in the Open Educational Resource (OER) movement and in Open Educational Licenses (like Creative Commons). Many of the projects on OER were funded by the William and Flora Hewlett Foundation, and partly also by the Shuttleworth Foundation that focuses on projects concerning collaborative content creation. There has been a strong international debate on how to apply OER in practice and the UNESCO chaired a vivid discussion on this through its International Institute of Educational Planning (IIEP).

By the second half of 2006 it also became clear to some of the forerunners that OER and Free/Libre Open Source Software (FLOSS) do somehow belong together. As a result, the discussion groups of IIEP on OER and FLOSS were merged and forces were further joined through mergers with a related OECD campaign. What has still not become clear by now to most actors in the OER domain is that there are further links between the OER and the Free / Libre Open Source Software (FLOSS) movements, beyond the principles of "FREE" and "OPEN". The FLOSS model stands for more than this and, like e.g. Wikipedia, shows how users can become active "resource" creators and how those resources can be re-used and freely maintained. In OER on the other hand a focus is still on the traditional way of resource creation and role distributions. However, Teachers Without Borders, a non-profit based in Seattle, is currently developing a new OER website where members can take courses, discuss their findings with people around the world, and publish their work, all on the same website. Their goal is to connect educators and learners from around the world and give free access to a wide variety of courses, thus helping to close the education divide. www.teacherswithoutborders.org.

FLOSS communities are today known for producing good quality software using a different development approach than proprietary software producer. FLOSS is built by a community of volunteers and might be backed by companies that generate their

revenues by providing services related to the software. In more recent years FLOSS communities also gained attention for their community production and support models and regarding their way of knowledge creation and learning. FLOSS communities possess many characteristics that educational settings seek to apply such as:

1. Open and inclusive ethos: everyone can participate, no charges, no deadlines, lifelong participation
2. Up to date content; everyone can add, edit and update the content
3. Materials are usually the product of many authors with many contributions from people other than authors
4. Frequent releases and updates where product features and community structures are the result of a continuous re-negotiation / reflection process within a continuous development cycle
5. Prior learning outcomes and processes are systematically available through mailing lists, forums, commented code and further instructional materials (re-use)
6. A large support network; provided voluntarily by the community member in a collaborative manner nearly 24/7
7. Free Riders (lurker) welcome paradox – the more the better
8. New ICT solutions are adapted early by the community

Educational settings might be partly aware that FLOSS-like principles can benefit education, but there has been no structured and systematically approach on mapping and transferring them, or to develop new educational models and scenarios around them. The European Union funded FLOSSCom project is likely to be the first attempt to map the open source landscape from an educational point of view, but further research and work still remains to be done."[35]

With the advent of the Virtual Retinal Display (Figure 1) and its application to education, I was motivated to research the integration between the computer, the laser and human intelligence.[36] Through this search I found "the MIT Center for Collective Intelligence**. This program was established to answer a basic research question:** *How can people and computers be connected so that—collectively—they act more intelligently than any individuals, groups, or computers have ever done before?"*[37] *One of the most successful examples of collective intelligence at work over the internet today is Wikipedia. The open and collaborative platform of the Wikipedia model of knowledge creation and sharing has truly confirmed the assumptions of the best seller:* The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations. "First published in 2004, it is a book written by James Surowiecki about the aggregation of information in groups, resulting in decisions that, he argues, are often better than could have been made by any single member of the group. The book presents numerous case studies and anecdotes to illustrate its argument, and touches on several fields, primarily economics and psychology."[38]

Figure 6. The ASCII codes for the word "Wikipedia" represented in binary, the numeral system most commonly used for encoding computer information.[39] An investigation performed by the scientific review, Nature, on Wikipedia and Britannica science entries, found that the two encyclopedias have similar degrees of accuracy in their content. Credit: courtesy of Wikipedia.[40]

Another significant study about the collective intelligence of the Wikipedia model is Wikinomics: How Mass Collaboration Changes Everything by Don Tapscott and Anthony D. Williams. I found this book to be truly relevant, inspiring, accurate and informative. The authors have successfully given an updated account of the profound revolution that the open source movement is leading on the World Wide Web. This book provides a multidimensional coherent narrative about the democratization of science, business and education. It is also a great resource for those who would like to participate in this new collaborative culture. The social character of the internet and its universal access to human knowledge, wisdom and wealth is clearly stated. The message of this book

is deeply encouraging and positive. Read it, listen to it, study it and live it! Wikinomics states that "throughout history corporations have organized themselves according to strict hierarchical lines of authority. Everyone was a subordinate to someone else—employees versus managers, marketers versus customers, producers versus supply chain subcontractors, companies versus the community. There was always someone or some company in charge, controlling things, at the "top" of the food chain. While hierarchies are not vanishing, profound changes in the nature of technology, demographics, and the global economy are giving rise to powerful new models of production based on community, collaboration, and self-organization rather than on hierarchy and control. Wiki: (from Wikipedia figure 6) a Web site that allows visitors to add, remove, edit and change content, typically without the need for registration. It also allows for linking among any number of pages. This ease of inter-action and operation makes a wiki an effective tool for mass collaborative authoring. The term wiki also can refer to the collaborative software itself (wiki engine) that facilitates the operation of such a site." [41]

One of the best free e-book that argues for the public domain is: THE CONSERVATIVE NANNY STATE. How the Wealthy Use the Government to Stay Rich and Get Richer by Dean Baker@ http://www.conservativenannystate.org. Two Amazon reviewers give us a brief but accurate intro. "This is a neat little book. Dean Baker is an economist at the Center for Economic and Policy Research @ http://www.cepr.net, a think tank with tons of fresh ideas - and he knows his stuff. He offers his take on issues such as trade agreements, monetary policy, CEO compensation, intellectual property, etc. and with each of these he demonstrates how the interests of the rich dominate. For example, proponents of NAFTA support "free trade" for manufacturing goods produced by low skilled workers but oppose free trade in high skill occupations (law, medicine, accountancy, etc.) which leads to a great divergence in the income distribution. In each of the chapters Dean Baker argues clearly and persuasively. Do you want to know what share of private R&D spending in pharmaceuticals goes to unnecessary copycat drugs? Do you want to know why a corporation cannot exist in a truly free market? Do you want to hear why marginal productivity does not determine CEO pay? Get this book"... "This book gives a great introduction to how a variety of industries get breaks from the system, so for example, how drug companies take tax money (through the NIH-The National Institutes of Health) and then after successfully creating a new drug, patent it to create a monopoly. It's a wonderful introduction to what's wrong in our mixed market economy."[42]

Figure 7. Credit: courtesy of CorpWatch.org

Originally it was Noam Chomsky who opened my eyes to how the US triple helix and the global economy actually works. He liberated my mind from the propaganda system of corporate media, activated my moral sense and made me aware of the amoral character of the corporation. He gave me the intellectual clarity to see the historical basis of this intellectual property issue between the public and the private sphere. In a CorpWatch interview Chomsky gives us not only a historical outline of the internet but also of the corporation and its relation to the US constitution: Noam Chomsky on Microsoft and Corporate Control of the Internet @ CorpWatch May 6th, 1998 CorpWatch's Anna Couey and Joshua Karliner caught up with Noam Chomsky by telephone at his home in the Boston area to ask him about Microsoft and Bill Gates. The following is a transcript of our far ranging conversation.

CW: *So our first question is, how significant do you see the recent skirmishes between the Department of Justice and Microsoft? Do you see it as an important turn of events?*

NC: There's some significance. We shouldn't exaggerate it. If there are three major corporations controlling what is essentially public property and a public creation, namely the Internet, telecommunications, and so on, that's not a whole lot better than one corporation controlling, but it's maybe a minor difference. The question is to what extent parasites like Microsoft should be parasites off the public system, or should be granted any rights at all.

CW: *Give us a little bit of historical context. How does what's happening with Microsoft's growing power, and its role in society fit into the history of U.S. Corporate power, the evolution of corporations?*

NC: Here's a brief history, a thumbnail sketch.

There were corporations as far back as the 18th century, and beyond. In the United States, corporations were public bodies. Basically, they were associations. A bunch of people could get together and say we want to build a bridge over this river, and could get a state charter which allowed them to do that, precisely that and nothing more. The corporation had no rights of individual persons.

The model for the corporation back at the time of the framing of the Constitution was a municipality. Through the 19th century, that began to change.

It's important to remember that the constitutional system was not designed in the first place to defend the rights of people. Rather, the rights of people had to be balanced, as Madison put it, against what he called "the rights of property." Well of course, property has no rights: my pen has no rights. Maybe I have a right to it, but the pen has no rights. So, this is just a code phrase for the rights of people with property. The constitutional system was founded on the principle that the rights of people with property have to be privileged; they have rights because they're people, but they also have special rights because they have property. As Madison put it in the constitutional debates, the goal of government must be "to protect the minority of the opulent against the majority." That's the way the system was set up.

In the United States, around the turn of the century, through radical judicial activism, the courts changed crucially the concept of the corporation. They simply redefined them so as to grant not only privileges to property owners, but also to what legal historians call "collectivist legal entities." Corporations, in other words, were granted early in this century the rights of persons, in fact, immortal persons, and persons of immense power. And they were freed from the need to restrict themselves to the grants of state charters.

That's a very big change. It's essentially establishing major private tyrannies, which are furthermore unaccountable, because they're protected by First Amendment rights, freedom from search and seizure and so on, so you can't figure out what they're doing.

After the Second World War, it was well understood in the business world that they were going to have to have state coordination, subsidy, and a kind of socialization of costs and risks. The only question was how to do that. The method that was hit upon pretty quickly was the "Pentagon system" (including the DOE, AEC, NASA). These publicly-subsidized systems have been the core of the dynamic sectors of the American economy ever since (much the same is true of biotechnology, pharmaceuticals, etc., relying on different public sources). And that certainly leads right to Microsoft.

So how does Microsoft achieve its enormous profits? Well, Bill Gates is pretty frank about it. He says they do it by "embracing and extending" the ideas of others. They're based on computers, for example. Computers were created at public expense and public initiative. In the 1950s when they were being developed, it was about 100% public expense. The same is true of the Internet. The ideas, the initiatives, the software, the hardware -- these were created for about 30 years at public initiative and expense, and it's just now being handed over to guys like Bill Gates.

CW: *What are the social and cultural impacts of allowing, not only a monopoly, but even if it's just a few large corporations, dominating something as basic as human speech, communication with each other?*

NC: It's a form of tyranny. But, that's the whole point of corporatization -- to try to remove the public from making decisions over their own fate, to limit the public arena, to control opinion, to make sure that the fundamental decisions that determine how the world is going to be run -- which includes production, commerce, distribution, thought, social policy, foreign policy, everything -- are not in the hands of the public, but rather in the hands of highly concentrated private power. In effect, tyranny unaccountable to the public. And there are various modalities for doing this. One is to have the communication system, the so-called information system, in the hands of a network of, fewer or more doesn't matter that much, private tyrannies.

Let's take the media in the United States. These are corporate media, overwhelmingly. Even the so-called public media are not very different. They are just huge corporations that sell audiences to advertisers in other businesses. And they're supposed to constitute the communications system. It's not complicated to figure out what's going to come out of this. That includes also the entertainment industries, so-called, the various modalities for diverting people from the public arena, and so on.

And there are new things happening all the time. Like right at this minute, there's a dramatic example, that's the Multilateral Agreement on Investment (MAI), which is supposed to be signed this month, but they're not going to make it. The negotiations have been going on in secret for about three years. It's essentially a huge corporate power play, trying to give "investors" -- that doesn't mean the guy working on the shop floor, it means the board of directors of GE, of Merrill Lynch, and so on -- to give investors extraordinary rights. That's being done in secret because the people involved, which is the whole business community incidentally, know that the public is going to hate it. So therefore the media are keeping it secret. And it's an astonishing feat for three years to keep quiet about what everyone knows to be a major set of decisions, which are going to lock countries into certain arrangements. It'll prevent public policy. Now you can argue that it's a good thing, a bad thing, you can argue what you like, but there's no doubt about how the public is going to react, and there's no doubt about the fact that the media, which have been well aware of this from the beginning have succeeded in virtually not mentioning it.

CW: *How would a company like Microsoft benefit from the MAI?*

NC: They could move capital freely. They could invest it where they like. There would be no restrictions on anything they do. A country, or a town, like say, Cambridge, Massachusetts, where I live, where I work, could not impose conditions on consumer protection, environmental control, investment and set-asides for minorities or women, you name it, that would be ruled out.

Now exactly how far this would go depends on the disposition to enforce it. These things are not determined by words. There's nothing in the Constitution, or the amendments to the Constitution, which allows private tyrannies to have the right to personhood. It's just power, not the wording. What the MAI would mean in practice depends on what the power relations are, like whether people

object to it so strenuously they won't allow it to happen, maybe by riots, or whatever. So those are the terms that they're going to try to impose.

A crucial element of this is what they call the ratchet effect; that is existing legislation is to be allowed, but it has to be removed over time. It has to be rolled back, and no new legislation can be introduced conflicting with the rights of Microsoft to do anything they like in the international arena, or domestically. Well over time that's supposed to have a ratchet effect, to turn the world over more and more in the hands of the major private tyrannies, like Microsoft, with their alliances and interactions.

CW: *Economist Brian Arthur argues that with the rapidly changing nature of technology, no one will remain in a monopoly position for long, so that monopoly power in the technology industries is different than what we've historically seen, and is nothing to worry about.*

NC: But there never was monopoly power; or there very rarely was monopoly power. Take highly concentrated power systems, like the energy industries. But they're not strictly speaking monopolies. Shell and Exxon are competitors. This is a highly managed system of market administration, with enormous state power entering in the interests of a small collection of private tyrannies.

It's very rare to find a real monopoly. AT&T was a monopoly for a time, that's why it could create things like the transistor, for example. It was a monopoly, so therefore they could charge high rates. But that's certainly unusual.

CW: *Do you think the whole monopoly issue is something to be concerned about?*

NC: These are oligopolies; they are small groups of highly concentrated power systems which are integrated with one another. If one of them were to get total control of some system, other powers probably wouldn't allow it. In fact, that's what you're seeing.

CW: *So, you don't think Bill Gates is a latter-day John D. Rockefeller?*

NC: John D. Rockefeller wasn't a monopolist. Standard Oil didn't run the whole industry; they tried. But other power centers simply don't want to allow that amount of power to one of them.

CW: *Then in fact, maybe there is a parallel there between Gates and Rockefeller, or not?*

NC: Think of the feudal system. You had kings and princes and bishops and lords and so on. They for the most part did not want power to be totally concentrated, they didn't want total tyrants. They each had their fiefdoms they wanted to maintain in a system of highly concentrated power. They just wanted to make sure the population, the rabble so-called, wouldn't be part of it. It's for this reason the question of monopoly -- I don't want to say it's not important -- but it's by no means the core of the issue.

It is indeed unlikely that any pure monopoly could be sustained. Remember that this changing technology that they're talking about is overwhelmingly technology that's developed at public initiative and public expense. Like the Internet after all, 30 years of development by the public then handed over to private power. That's market capitalism.

CW: *How has that transfer from the public to the private sphere changed the Internet?*

NC: As long as the Internet was under control of the Pentagon, it was free. People could use it freely [for] information sharing. That remained true when it stayed within the state sector of the National Science Foundation.

As late as about 1994, people like say, Bill Gates, had no interest in the Internet. He wouldn't even go to conferences about it, because he didn't see a way to make a profit from it. Now it's being handed over to private corporations, and they tell you pretty much what they want to do. They want to take large parts of the Internet and cut it out of the public domain altogether, turn it into intranets, which are fenced off with firewalls, and used simply for internal corporate operations.

They want to control access, and that's a large part of Microsoft's efforts: control access in such a way that people who access the Internet will be guided to things that *they* want, like home marketing service, or diversion, or something or other. If you really know exactly what you want to find, and have enough information and energy, you may be able to find what you want. But they want to make that as difficult as possible. And that's perfectly natural. If you were on the board of directors of Microsoft, sure, that's what you'd try to do.

Well, you know, these things don't *have* to happen. The public institution created a public entity which can be kept under public control. But that's going to mean a lot of hard work at every level, from Congress down to local organizations, unions, other citizens' groups which will struggle against it in all the usual ways.

CW: *What would it look like if it were under public control?*

NC: It would look like it did before, except much more accessible because more people would have access to it. And with no constraints. People could just use it freely. That has been done, as long as it was in the public domain. It wasn't perfect, but it had more or less the right kind of structure. That's what Microsoft and others want to destroy.

CW: *And when you say that, you're referring to the Internet as it was 15 years ago.*

NC: We're specifically talking about the Internet. But more generally the media has for most of this century, and increasingly in recent years, been under corporate power. But that's not always been the case. It doesn't have to be the case. We don't have to go back very far to find differences. As recently as the 1950s, there were about 800 labor newspapers reaching 20-30 million people a week, with a very different point of view. You go back further, the community-based and labor-based and other media were basically on par with the corporate media early in this century. These are not laws of nature, they're just the results of high concentration of power granted by the state through judicial activism and other private pressure, which can be reversed and overcome.

CW: *So take the increasing concentration in the technology that we're looking at with Microsoft and some of these other companies, and compare it with recent mergers in the defense, media, insurance, and banking industries, and especially the context of globalization. Are we looking at a new stage in global capitalism, or is this just a continuation of business as usual?*

NC: By gross measures, contemporary globalization is bringing the world back to what it was about a century ago. In the early part of the century, under basically British domination and the gold standard, if you look at the amount of trade, and then the financial flow, and so on, relative to the size of the economy, we're pretty much returning to that now, after a decline between the two World Wars.

Now there are some differences. For example, the speed of financial transactions has been much enhanced in the last 25 years through the so-called telecommunications revolution, which was a revolution largely within the state sector. Most of the system was designed, developed, and maintained at public expense, then handed over to private profit.

State actions also broke down the post-war international economic system, the Bretton Woods system in the early 1970s. It was dismantled by Richard Nixon, with US and British initiative primarily. The system of regulation of capital flows was dismantled, and that, along with the state-initiated telecommunications revolution led to an enormous explosion of speculative capital flow, which is now well over a trillion dollars a day, and is mostly non-productive. If you go back to around 1970, international capital flows were about 90% related to the real economy, like trade and investment. By now, at most a few percent are related to the real economy. Most have to do with financial manipulations, speculations against currencies, things which are really destructive to the economy. And that is a change that wasn't true, not only wasn't true 100 years ago, it wasn't true 40 years ago. So there are changes. And you can see their effects.

That's surely part of the reason for the fact that the recent period, the last 25 years, has been a period of unusually slow economic growth, of low productivity growth, of stagnation or decline of wages and incomes for probably two thirds of the population, even in a rich country like this. And enormously high profits for a very small part of the population. And it's worse in the Third World.

You can read in the New York Times, the lead article in the "Week in Review" yesterday, Sunday, April 12, that America is prospering and happy. And you look at the Americans they're talking about, it turns out it's not the roughly two thirds of the population whose incomes are stagnating or declining, it's the people who own stock. So, ok, they're undoubtedly doing great, except that about 1% of households have about 50% of the stock, and it's roughly the same with other assets. Most of the rest is owned by the top 10% of the population. So sure, America is happy, and America is prosperous, if America means what the New York Times means by it. They're the narrow set of elites that they speak for and to.

CW: *We are curious about this potential for many-to-many communications, and the fact that software, as a way of doing things carries cultural values, and impacts language and perception. And what kind of impacts there are around having technology being developed by corporations such as Microsoft.*

NC: I don't think there's really any answer to that. It depends who's participating, who's active, who's influencing the direction of things, and so on. If it's being influenced and controlled by the Disney Corporation and others it will reflect their interests. If there is largely public initiative, then it will reflect public interests.

CW: *So it gets back to the question of taking it back.*

NC: That's the question. Ultimately it's a question of whether democracy's going to be allowed to exist, and to what extent. And it's entirely natural that the business world, along with the state, which they largely dominate, would want to limit democracy. It threatens them. It always has been threatening. That's why we have a huge public relations industry dedicated to, as they put it, controlling the public mind.

CW: *What kinds of things can people do to try to expand and reclaim democracy and the public space from corporations?*

NC: Well, the first thing they have to do is find out what's happening to them. So if you have none of that information, you can't do much. For example, it's impossible to oppose, say, the Multilateral Agreement on Investment, if you don't know it exists. That's the point of the secrecy. You can't oppose the specific form of globalization that's taking place, unless you understand it. You'd have to not only read the headlines which say market economy's triumphed, but you also have to read Alan Greenspan, the head of the Federal Reserve, when he's talking internally; when he says, look the health of the economy depends on a wonderful achievement that we've brought about, namely "worker insecurity." That's his term. Worker insecurity--that is not knowing if you're going to have a job tomorrow. It is a great boon for the health of the economy because it keeps wages down. It's great: it keeps profits up and wages down.

Well, unless people know those things, they can't do much about them. So the first thing that has to be done is to create for ourselves, for the population, systems of interchange, interaction, and so on. Like CorpWatch, Public Citizen, other popular groupings, which provide to the public the kinds of information and understanding that they won't otherwise have. After that they have to struggle against it, in lots of ways which are open to them. It can be done right through pressure on Congress, or demonstrations, or creation of alternative institutions. And it should aim, in my opinion, not just at narrow questions, like preventing monopoly, but also at deeper questions, like why do private tyrannies have rights altogether?

CW: *What do you think about the potential of all the alternative media that's burgeoning on the Internet, given the current trends?*

NC: That's a matter for action, not for speculation. It's like asking 40 years ago what's the likelihood that we'd have a minimal health care system like Medicare? These things happen if people struggle for them. The business world, Microsoft, they're highly class conscious. They're basically vulgar Marxists, who see themselves engaged in a bitter class struggle. Of course they're always going to be at it. The question is whether they have that field to themselves. And the deeper question is whether they should be allowed to participate; I don't think they should.[43]

State Capitalism as the Core of the US and the Global Economy

More generally, it was Chomsky's distinction between democracy and state capitalism that grounded my awareness of these social issues. "To begin with, I think terms like "capitalism" and "socialism" have been so evacuated of any substantive meaning that I don't even like to use them. There's nothing remotely like capitalism in existence. To the extent there ever was, it had disappeared by the 1920s or '30s. Every industrial society is one form or another of state capitalism."[44] According to Wikipedia "State capitalism, for Marxists and heterodox economists is a way to describe a society wherein the productive forces are owned and run by the state in a capitalist way, even if such a state calls itself socialist.[1] Within Marxist literature, state capitalism is usually defined in this sense: as a social system combining capitalism — the wage system of producing and appropriating surplus value — with ownership by a state apparatus. By that definition, a state capitalist country is one where the government controls the economy and essentially acts like a single giant corporation… here are various theories and critiques of state capitalism, some of which have been around since the October Revolution (Russia1917).[45] The common themes among them are to identify that the workers do not meaningfully control the means of production and that commodity relations and production for profit still occur within state capitalism. This term is also used by classical liberals and advocates of capital to mean a private capitalist economy under state control. This term was often used to describe the controlled economies of the great powers in the First World War.[3] In more modern sense, state capitalism is a term that is used (sometimes interchangeably with state monopoly capitalism) to describe a system where the state is intervening in the markets to protect and advance interests of Big Business. This practice is in sharp contrast with the ideals of free market capitalism…[4]

An alternate definition is that state capitalism is a close relationship between the government and private capitalism, such as one in which the private capitalists produce for a guaranteed market. An example of this would be the military-industrial complex where autonomous entrepreneurial firms produce for lucrative government contracts and are not subject to the discipline of competitive markets… Murray Rothbard, a laissez-faire capitalist thinker, uses the term interchangeably with the term state monopoly capitalism, and uses it to describe a partnership of government and big business where the state is intervening on behalf of large capitalists against the interests of consumers.[7][8] He distinguishes this from laissez-faire capitalism where big business is not protected from market forces. This usage dates from the 1960s, when Harry Elmer Barnes described the post-New Deal economy in the United States as "state capitalism." More recently, Andrei Illarionov, former economic advisor to Russian President Vladimir Putin, resigned in December 2005, protesting Russia's "embracement of state capitalism."[9] The term is not used by the classical liberals to describe the public ownership of the means of production. The economist Ludwig von Mises explains the reason: "The socialist movement takes great pains to circulate frequently new labels for its ideally constructed state. Each worn-out label is replaced by another which raises hopes of an ultimate solution of the insoluble basic problem of Socialism—until it becomes obvious that nothing has been changed but the name. The most recent slogan is "State Capitalism." It is not commonly realized that this covers nothing more than what used to be called Planned Economy and State Socialism, and that State Capitalism, diverge only in non-essentials from the "classic" ideal of egalitarian Socialism."[46] Actually this last statement by Ludwig von Mises is a half truth, as you will clearly see ahead State Capitalism is really socialism for the rich or corporate welfare. Let's fast-forward to today and see how relevant Chomsky's economic vision truly is.

Understanding the Crisis - Markets, the State and Hypocrisy

February 18, 2009 By Noam Chomsky and Sameer Dossani

Source: Foreign Policy In Focus

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February 10, 2009 -- Noam Chomsky is a noted linguist, author, and foreign policy expert. Sameer Dossani interviewed him about the global economic crisis and its roots.

SAMEER DOSSANI: In any first year economics class, we are taught that markets have their ups and downs, so the current recession is perhaps nothing out of the ordinary. But this particular downturn is interesting for two reasons: First, market deregulation in the 1980s and 1990s made the boom periods artificially high, so the bust period will be deeper than it would otherwise. Secondly, despite an economy that's boomed since 1980, the majority of working class U.S. residents have seen their incomes stagnate — while the rich have done well most of the country hasn't moved forward at all. Given the situation, my guess is that economic planners are likely to go back to some form of Keynesianism, perhaps not unlike the Bretton Woods system that was in place from 1948-1971. What are your thoughts?

NOAM CHOMSKY: Well I basically agree with your picture. In my view, the breakdown of the Bretton Woods system in the early 1970s is probably *the* major international event since 1945, much more significant in its implications than the collapse of the Soviet Union. From roughly 1950 until the early 1970s there was a period of unprecedented economic growth and egalitarian economic growth. So the lowest quintile did as well — in fact they even did a little bit better — than the highest quintile. It was also a period of some limited but real form of benefits for the population. And in fact social indicators, measurements of the health of society, they very closely tracked growth. As growth went up social indicators went up, as you'd expect. Many economists called it the golden age of modern capitalism — they should call it state capitalism because government spending was a major engine of growth and development.

In the mid 1970s that changed. Bretton Woods restrictions on finance were dismantled, finance was freed, speculation boomed, huge amounts of capital started going into speculation against currencies and other paper manipulations, and the entire economy became financialized. The power of the economy shifted to the financial institutions, away from manufacturing. And since then, the majority of the population has had a very tough time; in fact it may be a unique period in American history. There's no other period where real wages — wages adjusted for inflation — have more or less stagnated for so long for a majority of the population and where living standards have stagnated or declined. If you look at social indicators, they track growth pretty closely until 1975, and at that point they started to decline, so much so that now we're pretty much back to the level of 1960. There was growth, but it was highly inegalitarian — it went into a very small number of pockets. There have been brief periods in which this shifted, so during the tech bubble, which was a bubble in the late Clinton years, wages improved and unemployment went down, but these are slight deviations in a steady tendency of stagnation and decline for the majority of the population.

Financial crises have increased during this period, as predicted by a number of international economists. Once financial markets were freed up, there was expected to be an increase in financial crises, and that's happened. This crisis happens to be exploding in the rich countries, so people are talking about it, but it's been happening regularly around the world — some of them very serious — and not only are they increasing in frequency but they're getting deeper. And it's been predicted and discussed and there are good reasons for it.

About 10 years ago there was an important book called Global Finance at Risk, by two well-known economists John Eatwell and Lance Taylor. In it they refer to the well-known fact that there are basic inefficiencies intrinsic to markets. In the case of financial markets, they under-price risk. They don't count in systemic risk — general social costs. So for example if you sell me a car, you and I may make a good bargain, but we don't count in the costs to the society — pollution, congestion and so on. In financial markets, this means that risks are under-priced, so there are more risks taken than would happen in an efficient system. And that of course leads to crashes. If you had adequate regulation, you could control and prevent market inefficiencies. If you deregulate, you're going to maximize market inefficiency.

This is pretty elementary economics. They happen to discuss it in this book; others have discussed it too. And that's what's happening. Risks were under-priced, therefore more risks were taken than should have been, and sooner or later it was going to crash. Nobody predicted exactly when, and the depth of the crash is a little surprising. That's in part because of the creation of exotic financial instruments which were deregulated, meaning that nobody really knew who owed what to whom. It was all split up in crazy ways. So the depth of the crisis is pretty severe — we're not to the bottom yet — and the architects of this are the people who are now designing Obama's economic policies.

Dean Baker, one of the few economists who saw what was coming all along, pointed out that it's almost like appointing Osama

bin Laden to run the so-called war on terror. Robert Rubin and Lawrence Summers, Clinton's treasury secretaries, are among the main architects of the crisis. Summers intervened strongly to prevent any regulation of derivatives and other exotic instruments. Rubin, who preceded him, was right in the lead of undermining the Glass-Steagall act, all of which is pretty ironic. The Glass-Steagall Act protected commercial banks from risky investment firms, insurance firms, and so on, which kind of protected the core of the economy. That was broken up in 1999 largely under Rubin's influence. He immediately left the treasury department and became a director of Citigroup, which benefited from the breakdown of Glass-Steagall by expanding and becoming a "financial supermarket" as they called it. Just to increase the irony (or the tragedy if you like) Citigroup is now getting huge taxpayer subsidies to try to keep it together and just in the last few weeks announced that it's breaking up. It's going back to trying to protect its commercial banking from risky side investments. Rubin resigned in disgrace — he's largely responsible for this. But he's one of Obama's major economic advisors, Summers is another one; Summer's protégé Tim Geithner is the Treasury Secretary.

None of this is really unanticipated. There were very good economists like say David Felix, an international economist who's been writing about this for years. And the reasons are known: markets are inefficient; they under-price social costs. And financial institutions underprice systemic risk. So say you're a CEO of Goldman Sachs. If you're doing your job correctly, when you make a loan you ensure that the risk to you is low. So if it collapses, you'll be able to handle it. You do care about the risk to yourself, you price that in. But you don't price in systemic risk, the risk that the whole financial system will erode. That's not part of your calculation.

Well that's intrinsic to markets — they're inefficient. Robin Hahnel had a couple of very good articles about this recently in economics journals. But this is first year economics course stuff — markets are inefficient; these are some of their inefficiencies; there are many others. They can be controlled by some degree of regulation, but that was dismantled under religious fanaticism about efficient markets, which lacked empirical support and theoretical basis; it was just based on religious fanaticism. So now it's collapsing.

People talk about a return to Keynesianism, but that's because of a systematic refusal to pay attention to the way the economy works. There's a lot of wailing now about "socializing" the economy by bailing out financial institutions. Yeah, in a way we are, but that's icing on the cake. The whole economy's been socialized since — well actually forever, but certainly since the Second World War. This mythology that the economy is based on entrepreneurial initiative and consumer choice, well ok, to an extent it is. For example at the marketing end, you can choose one electronic device and not another. But the core of the economy relies very heavily on the state sector, and transparently so. So for example to take the last economic boom which was based on information technology — where did that come from? Computers and the Internet. Computers and the Internet were almost entirely within the state system for about 30 years — research, development, procurement, other devices — before they were finally handed over to private enterprise for profit-making. It wasn't an instantaneous switch, but that's roughly the picture. And that's the picture pretty much for the core of the economy.

The state sector is innovative and dynamic. It's true across the board from electronics to pharmaceuticals to the new biology-based industries. The idea is that the public is supposed to pay the costs and take the risks, and ultimately if there is any profit, you hand it over to private tyrannies, corporations. If you had to encapsulate the economy in one sentence, that would be the main theme. When you look at the details of course it's a more complex picture, but that's the major theme. So yes, socialization of risk and cost (but not profit) is partially new for the financial institutions, but it's just added on to what's been happening all along.

Double Standard

DOSSANI: As we consider the picture of the collapse of some of these major financial institutions we would do well to remember that some of these same market fundamentalist policies have already been exported around the globe. Specifically, the International Monetary Fund has forced an export-oriented growth model onto many countries, meaning that the current slowdown in U.S. consumption is going to have major impacts in other countries. At the same time, some regions of the world, particularly the Southern Cone region of South America, are working to repudiate the IMF's market fundamentalist policies and build up alternatives. Can you talk a little about the international implications of the financial crisis? And how is it that some of the institutions responsible for this mess, like the IMF, are using this as an opportunity to regain credibility on the world stage?

CHOMSKY: It's rather striking to notice that the consensus on how to deal with the crisis in the rich countries is almost the opposite of the consensus on how the poor countries should deal with similar economic crises. So when so-called developing countries have a financial crisis, the IMF rules are: raise interest rates, cut down economic growth, tighten the belt, pay off your debts (to us), privatize, and so on. That's the opposite of what's prescribed here. What's prescribed here is lower interest rates, pour government money into stimulating the economy, nationalize (but don't use the word), and so on. So yes, there's one set of rules for the weak and a different set of rules for the powerful. There's nothing novel about that.

As for the IMF, it is not an independent institution. It's pretty much a branch of the U.S. Treasury Department — not officially, but that's pretty much the way it functions. The IMF was accurately described by a U.S. Executive Director as "the credit community's enforcer." If a loan or an investment from a rich country to a poor country goes bad, the IMF makes sure that the lenders will not suffer. If you had a capitalist system, which of course the wealthy and their protectors don't want, it wouldn't work like that.

For example, suppose I lend you money, and I know that you may not be able to pay it back. Therefore I impose very high interest rates, so that at least I'll get that in case you crash. Then suppose at some point you can't pay the debt. Well in a capitalist system it

would be my problem. I made a risky loan, I made a lot of money from it by high interest rates and now you can't pay it back? Ok, tough for me. That's a capitalist system. But that's not the way our system works. If investors make risky loans to say Argentina and get high interest rates and then Argentina can't pay it back, well that's when the IMF steps in, the credit community's enforcer, and says that the people of Argentina, they have to pay it back. Now if you can't pay back a loan to me, I don't say that your neighbors have to pay it back. But that's what the IMF says. The IMF says the people of the country have to pay back the debt which they had nothing to do with, it was usually given to dictators, or rich elites, who sent it off to Switzerland or someplace, but you guys, the poor folks living in the country, you have to pay it back. And furthermore, if I lend money to you and you can't pay it back, in a capitalist system I can't ask my neighbors to pay me, but the IMF does, namely the US taxpayer. They help make sure that the lenders and investors are protected. So yes it's the credit community's enforcer. It's a radical attack on basic capitalist principles, just as the whole functioning of the economy based on the state sector is, but that doesn't change the rhetoric. It's kind of hidden in the woodwork.

What you said about the Southern Cone is exactly right. For the last several years they've been trying to extricate themselves from this whole neoliberal disaster. One of the ways was, for example Argentina simply didn't pay back its debts, or rather restructured them and bought some of it back. And folks like the President of Argentina said that "we're going to rid ourselves of the IMF" through these measures. Well, what was happening to the IMF? The IMF was in trouble. It was losing capital and losing borrowers, and therefore losing its ability to function as the credit community's enforcer. But this crisis is being used to restructure it and revitalize it.

It's also true that countries are driven to commodity export; that's the mode of development that's designed for them. Then they will be in trouble if commodity prices fall. It's not 100% the case, but in the Southern Cone, the countries that have been doing reasonably well do rely very heavily on commodity export, actually raw material export. That's even true of the most successful of them, Chile, which is considered the darling. The Chilean economy has been based very heavily on copper exports. The biggest copper company in the world is CODELCO, the nationalized copper company — nationalized by President Salvador Allende and nobody has tried to privatize it fully since because it's such a cash cow. It has been undermined, so it controls less of the copper export than it has in the past, but it still provides a large part of the tax base of the Chilean economy and is also a large income producer. It's an efficiently run nationalized copper company. But reliance on copper export means you're vulnerable to a decline in the price of commodities. The other Chilean exports like say, fruit and vegetables which are adapted to the U.S. market because of the seasonal differences — that's also vulnerable. And they haven't really done much in developing the economy beyond reliance on raw materials exports — a little, but not much. The same can be said for the other currently successful countries. You look at growth rates in Peru and Brazil, they're heavily dependent on soy and other agricultural exports or minerals; it's not a solid base for an economy.

One major exception to this is South Korea and Taiwan. They were very poor countries. South Korea in the late 1950s was probably about the level of Ghana today. But they developed by following the Japanese model - violating all the rules of the IMF and Western economists and developing pretty much the way the Western countries had developed, by substantial direction and involvement of the state sector. So South Korea, for example built a major steel industry, one of the most efficient in the world, by flatly violating the advice of the IMF and the World Bank, who said it was impossible. But they did it through state intervention, directing of resources, and also by restricting capital flight. Capital flight is a major problem for a developing country, and also for democracy. Capital flight could be controlled under Bretton Woods rules, but it was opened up in the last 30 years. In South Korea, you could get the death penalty for capital flight. So yes, they developed a pretty solid economy, as did Taiwan. China is a separate story, but they also radically violated the rules, and it's a complex story of how it's ending up. But these are major phenomena in the international economy.

Government Investment

DOSSANI: Do you think the current crisis will offer other countries the opportunity to follow the example of South Korean and Taiwan?

CHOMSKY: Well, you could say the example of the United States. During its major period of growth - late 19th century and early 20th century - the United States was probably the most protectionist country in the world. We had very high protective barriers, and it drew in investment, but private investment played only a supporting role. Take the steel industry. Andrew Carnegie built the first billion-dollar corporation by feeding off the state sector — building naval vessels and so on — this is Carnegie the great pacifist. The sharpest period of economic growth in U.S. history was during the Second World War, which was basically a semi-command economy and industrial production more than tripled. That model pulled us out of the depression, after which we became far and away the major economy in the world. After the Second World War, the substantial period of economic growth which I mentioned (1948-1971) was very largely based on the dynamic state sector and that remains true.

Let's take my own institution, MIT. I've been here since the 1950s, and you can see it first hand. In the 1950s and 1960s, MIT was largely financed by the Pentagon. There were labs that did classified war work, but the campus itself wasn't doing war work. It was developing the basis of the modern electronic economy: computers, the Internet, microelectronics, and so on. It was all developed under a Pentagon cover. IBM was here learning how to shift from punch-cards to electronic computers. It did get to a point by the 1960s that IBM was able to produce its own computers, but they were so expensive that nobody could buy them so therefore the government bought them. In fact, procurement is a major form of government intervention in the economy to develop the fundamental structure that will ultimately lead to profit. There have been good technical studies on this. From the 1970s until today, the funding of MIT has been shifting away from the Pentagon and toward the National Institute of Health and related government institutions. Why? Because the cutting edge of the economy is shifting from an electronics base to a biology base. So now the public has to pay the costs of the next phase of the economy through other state institutions. Now again, this is not the whole story, but it's a substantial part.

There will be a shift towards more regulation because of the current catastrophe, and how long they can maintain the paying off banks and financial institutions is not very clear. There will be more infrastructure spending, surely, because no matter where you are in the economic spectrum you realize that it's absolutely necessary. There will have to be some adjustment in the trade deficit, which is dramatic, meaning less consumption here, more export, and less borrowing.

And there's going to have to be some way to deal with the elephant in the closet, one of the major threats to the American economy, the increase in healthcare costs. That's often masked as "entitlements" so that they can wrap in Social Security, as part of an effort to undermine Social Security. But in fact Social Security is pretty sound; probably as sound as its ever been, and what problems there are could probably be addressed with small fixes. But Medicare is huge, and its costs are going way up, and that's primarily because of the privatized healthcare system which is highly inefficient. It's very costly and it has very poor outcomes. The U.S. has twice the per capita costs of other industrialized countries and it has some of the worst outcomes. The major difference between the U.S. system and others is that this one is so heavily privatized, leading to huge administrative costs, bureaucratization, surveillance costs and so on. Now that's going to have to be dealt with somehow because it's a growing burden on the economy and its huge; it'll dwarf the federal budget if current tendencies persist.

South America

DOSSANI: Will the current crisis open up space for other countries to follow more meaningful development goals?

CHOMSKY: Well, it's been happening. One of the most exciting areas of the world is South America. For the last 10 years there have been quite interesting and significant moves towards independence, for the first time since the Spanish and Portuguese conquests. That includes steps towards unification, which is crucially important, and also beginning to address their huge internal problems. There's a new Bank of the South, based in Caracas, which hasn't really taken off yet, but it has prospects and is supported by other countries as well. MERCOSUR is a trading zone of the Southern cone. Just recently, six or eight months ago, a new integrated organization has developed, UNASUR, the Union of South American Republics, and it's already been effective. So effective that it's not reported in the United States, presumably because it's too dangerous.

So when the U.S. and the traditional ruling elites in Bolivia started moving towards a kind of secessionist movement to try to undermine the democratic revolution that's taken place there, and when it turned violent, as it did, there was a meeting of UNASUR last September in Santiago, where it issued a strong statement defending the elected president, Evo Morales, and condemning the violence and the efforts to undermine the democratic system. Morales responded thanking them for their support and also saying that this is the first time in 500 years that South America's beginning to take its fate into its own hands. That's significant; so significant that I don't even think it was reported here. Just how far these developments can go, both dealing with the internal problems and also the problems of unification and integration, we don't know, but the developments are taking place. There are also South-South relations developing, for example between Brazil and South Africa. This again breaks the imperial monopoly, the monopoly of U.S. and Western domination. China's a new element on the scene. Trade and investment are increasing, and this gives more options and possibilities to South America. The current financial crisis might offer opportunities for increasing this, but also it might go the other way. The financial crisis is of course harming — it must harm — the poor in the weaker countries and it may reduce their options. These are really matters which will depend on whether popular movements can take control of their own fate, to borrow Morales' phrase. If they can, yes there are opportunities.

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The Federal Reserve System and the Corporations

The unaccountable tyrants that Chomsky calls the dictatorship of the Corporations justify their corrupted actions or abuse of power not only through the legal system of patents and copyrights but more systemically through their closely interlinked network to a self-interested, artificially created boom/bust cycle and debt-based monetary system called: The Federal Reserve System. This monetary system is the universal corrupter of all our industries and our ideas because it concentrates the creative resources of the nation and the world in the hands of a few corporations. To accomplish this monopoly of the resources it corrupts or distorts the very foundation of all human and natural relations between people, ideas and our planet. For me the great unraveling of this mysterious organization started with the book: Secrets of the Temple: How the Federal Reserve Runs the Country (Paperback) by William Greider (Author) "In the American system, citizens were taught that the transfer of political power accompanied elections, formal events when citizens made orderly choices about who shall..." From Publishers Weekly: In this penetrating study of the Federal Reserve Board in the Reagan era, Rolling Stone (now with the Nation Magazine) writer Greider (The Education of David Stockman) views the "Fed" chairman (until recently Paul Volcker) as the "second most powerful" officer of government, the high priest of a temple as mysterious as money itself, its processes unknown to the public and yet to be fully understood by any modern president. Controlling the money supply by secretly buying and selling government bonds and thus affecting interest rates, the Fed can manipulate billions in business profits or losses and millions in worker employment and stock, bond or bank account values, the author explains. Greider's conclusions are startling at times. The Fed, he maintains, could have prevented the 1929 crash. He also asserts the "awkward little secret" that the federal government deliberately induces recessions, usually to bring down inflation and interest rates, (a time-consuming but extremely informative read.)."[47]

For a visually clear, accurate and critical explanation of the mechanics as well as the social and global hegemonic structure of the Federal Reserve System in coordination with the World Bank, the International Monetary Fund (IMF) and the global Corporation's World Trade Organization see the: Zeitgeist: Addendum a free Documentary - 123 min - Oct 3, 2008.[48] According to Wikipedia "a large and varied group of criticisms has been directed against the Federal Reserve System. One critique, typified by the Austrian School, is that the Federal Reserve is an unnecessary and counterproductive interference in the economy. According to this theory, interest rates should be naturally low during times of excessive consumer saving (because lendable money is abundant) and naturally high when high net volumes of consumer credit are extended (because lendable money is scarce). These critics argue that setting a baseline lending rate amounts to centralized economic planning; a hallmark of socialist and communist societies; and inflating the currency amounts to a regressive, incremental redistribution of wealth.[94] Other critiques include arguments in favor of the gold standard (usually coupled with the charge that the Federal Reserve System is unconstitutional)[95] or beliefs that the centralized banking system is doomed to fail (due to the fractional reserve system's strong resemblance to an unsustainable pyramid scheme).[94] Some critics argue that the Fed lacks accountability and transparency or that there is a culture of secrecy within the Reserve.[96] The Federal Reserve Board Abolition Act is a proposed remedy to these issues. H.R. 2755 was introduced by Rep. Ron Paul (R-Texas) on June 15, 2007, and was then referred to the Committee on Financial Services. If passed, the bill would abolish the Federal Reserve Board and repeal the Federal Reserve Act.[49] You can update yourself with Dr. Paul's 2008 book; The Revolution: A Manifesto (Paperback or audio download) by Ron Paul…

An Amazon reviewer said and I agree in part. "The best and most important chapter, without a doubt, is Chapter 6, "Money: The Forbidden Issue in American Politics." Here Dr. Paul expertly details the operations of the Federal Reserve System in stunning clarity -- no conspiracy theories or half-truths that often further obfuscate discussion of the secretive monetary authority. The Austrian (and true) perspective on the Fed is not to be horrified that the Fed isn't a government agency (it is, even if indirectly), but to be outraged that all banks are essentially arms of the government. We don't need the government to have even more control over the money supply, we need it to have no control whatsoever, the exact opposite of what movies like FREEDOM TO FASCISM (a free YouTube download) seem to suggest.[50] What's more, Dr. Paul doesn't spread the myth that the Fed somehow profits as an entity when it creates money (its profits go to the Treasury), but instead, politically connected individuals and businesses profit at the expense of working-class and poor families. You see, the effects of inflation are not uniform -- the Fed System works as a wealth redistribution system from poor and middle-class to the rich and politically connected. How so? Buy this book and find out!" Even though I agree with most of Ron Paul's critique of the Fed, foreign policy and the damaging effect of militarism, I disagree with his traditional conservative premise of privatization and solution of restoring the gold standard, I firmly believe that the Federal Reserve System or any version of it is unsustainable and shall be abolished and replaced by the Open Resource Based Global Economy (ORBE, figure 8 below) in the near future.

A great article about the current state of affairs was written by the recent Nobel economist:

The Madoff Economy December 21, 2008 By Paul Krugman
Source: NYT Paul Krugman's ZSpace Page

"The revelation that Bernard Madoff - brilliant investor (or so almost everyone thought), philanthropist, pillar of the community - was a phony has shocked the world, and understandably so. The scale of his alleged $50 billion Ponzi scheme is hard to comprehend.

Yet surely I'm not the only person to ask the obvious question: How different, really, is Mr. Madoff's tale from the story of the investment industry as a whole?

The financial services industry has claimed an ever- growing share of the nation's income over the past generation, making the people who run the industry incredibly rich. Yet, at this point, it looks as if much of the industry has been destroying value, not creating it. And it's not just a matter of money: the vast riches achieved by those who managed other people's money have had a corrupting effect on our society as a whole.

Let's start with those paychecks. Last year, the average salary of employees in "securities, commodity contracts, and investments" was more than four times the average salary in the rest of the economy. Earning a million dollars was nothing special and even incomes of $20 million or more were fairly common. The incomes of the richest Americans have exploded over the past generation, even as wages of ordinary workers have stagnated; high pay on Wall Street was a major cause of that divergence.

But surely those financial superstars must have been earning their millions, right? No, not necessarily. The pay system on Wall Street lavishly rewards the appearance of profit, even if that appearance later turns out to have been an illusion.

Consider the hypothetical example of a money manager who leverages up his clients' money with lots of debt, then invests the bulked-up total in high-yielding but risky assets, such as dubious mortgage-backed securities. For a while - say, as long as a housing bubble continues to inflate - he (it's almost always a he) will make big profits and receive big bonuses. Then, when the bubble bursts and his investments turn into toxic waste, his investors will lose big - but he'll keep those bonuses.

O.K., maybe my example wasn't hypothetical after all.

So, how different is what Wall Street in general did from the Madoff affair? Well, Mr. Madoff allegedly skipped a few steps, simply stealing his clients' money rather than collecting big fees while exposing investors to risks they didn't understand. And while

Mr. Madoff was apparently a self-conscious fraud, many people on Wall Street believed their own hype. Still, the end result was the same (except for the house arrest): the money managers got rich; the investors saw their money disappear.

We're talking about a lot of money here. In recent years the finance sector accounted for 8 percent of America's G.D.P., up from less than 5 percent a generation earlier. If that extra 3 percent was money for nothing - and it probably was - we're talking about $400 billion a year in waste, fraud and abuse.

But the costs of America's Ponzi era surely went beyond the direct waste of dollars and cents.

At the crudest level, Wall Street's ill-gotten gains corrupted and continue to corrupt politics, in a nicely bipartisan way. From Bush administration officials like Christopher Cox, chairman of the Securities and Exchange Commission, who looked the other way as evidence of financial fraud mounted, to Democrats who still haven't closed the outrageous tax loophole that benefits executives at hedge funds and private equity firms (hello, Senator Schumer), politicians have walked when money talked.

Meanwhile, how much has our nation's future been damaged by the magnetic pull of quick personal wealth, which for years has drawn many of our best and brightest young people into investment banking, at the expense of science, public service and just about everything else?

Most of all, the vast riches being earned - or maybe that should be "earned" - in our bloated financial industry undermined our sense of reality and degraded our judgment.

Think of the way almost everyone important missed the warning signs of an impending crisis. How was that possible? How, for example, could Alan Greenspan have declared, just a few years ago, that "the financial system as a whole has become more resilient" - thanks to derivatives, no less? The answer, I believe, is that there's an innate tendency on the part of even the elite to idolize men who are making a lot of money, and assume that they know what they're doing.

After all, that's why so many people trusted Mr. Madoff.

Now, as we survey the wreckage and try to understand how things can have gone so wrong, so fast, the answer is actually quite simple: What we're looking at now are the consequences of a world gone Madoff." [51]

A prescient and dense but truthful account of the rise of the financial sector in American politics is powerfully delivered in: Bad Money: Reckless Finance, Failed Politics, and the Global Crisis of American Capitalism by Kevin Phillip. Review "A harrowing picture of national danger that no American reader will welcome, but that none should ignore. . . . Frighteningly persuasive."—Alan Brinkley, The New York Times "An indispensable presentation of the case against things as they are." —Time "Sobering . . . positively alarming."—Los Angeles Times --*This text refers to the* Paperback *edition.* For those who have read Kevin Phillips' American Theocracy: The Peril and Politics of Radical Religion, Oil, and Borrowed Money in the 21st Century, many of the themes in the current work will sound familiar. In this book, as well as American Theocracy, he reminds us that previous empires such a 17th century Spain, 18th century Holland, and the late 19th and early 20th century Britain all succumbed to financialization as their global power reached its peak. He argues the United States is now in a similar position. In the last 30 years financial services have grown from 11% of GDP to 21%, and manufacturing has declined from 25% to 13%, a reversal of roles that Phillips sees as very unhealthy.

This huge growth of the financial sector was not without adverse consequences: in the last 20 years public and private debt has quadrupled to $43 trillion (in addition to this general debt according to NPR the credit default swap or cds in particular bubbled up to $62 trillion).[52] How this came about has been expertly explained in another book called The Trillion Dollar Meltdown: Easy Money, High Rollers, and the Great Credit Crash by Charles Morris. There was easy money as the Federal Reserve was lending money at less than the rate of inflation. Money was risk-free for the lender since they collected fees up front and sold the securitized loans to investors. When this process was repeated millions of times, one ends up with hard-to-value securitized debt throughout the global economy. Then when housing prices start to decline and homeowners start to default on their mortgages on a grand scale, you have a global crisis of American capitalism. (Bear Stearns alone was estimated to be holding $46 billion worth of bad money.)

As in American Theocracy, Phillips writes that the oil industry is another component of the current crisis. In the US oil production peaked in the 1970s, on a global level it is peaking right about now. And with the ravenous appetite for oil from newly industrialized countries such as China and India, prices will continue to go up. The US still gets "cheap" oil relative to Europe since oil is priced in dollars, but that advantage may soon disappear. The weakening dollar is forcing OPEC countries to move to Euros and other currencies. And some oil producing countries such as Iran and Venezuela are moving to other currencies for reasons other than economic.

The author began his career as a Republican strategist, but he has long since disavowed them. Having a monetary policy of free money, a fiscal policy of tax cuts and increased spending, and an ideology of unregulated market fundamentalism, the Republicans have lost most of their credibility. This does not mean Phillips has gone over to the Democratic side. He believes that Bill Clinton was instrumental in the financialization of the economy, and that currently Hillary and Obama are beholden to investment bankers and hedge fund managers. What used to be the vital center in Washington is now the "venal center."

The conclusion of this volume is very gloomy. Phillips believes that we are at a pivotal moment in American history when the economy has been hollowed out, we are saddled with trillions of dollars of debt, and our political leaders are dishonest, incompetent,

and negligent. Given that all that may currently be the case, it may be instructive to further meditate on the empires of the past. Spain, Holland, and Britain all managed to survive and even thrive; hopefully the US will do the same."[53]

While it is true in great part that democrats in general are beholden to the financial sector, there is reason for hope in democracy thanks to the Obama Administration. It is important to point out that he was the first presidential candidate in US history to successfully demonstrate the political power of the open source platform (Linux operating system, Apache Server, MySQL database etc) for the World Wide Web and its emerging social networks. The Obama administration consulted with Laurence Lessig, one of the founders of the Creative Commons and utilized Blue State Digital. According to Wikipedia "Blue State Digital is a Washington, D.C.-based Internet strategy and technology firm. The company was founded in early 2004 by four former staffers of Howard Dean's 2004 presidential campaign: Clay A. Johnson, Jascha Franklin-Hodge, Joe Rospars, and Ben Self. They are involved in providing custom Internet applications and communications strategies to Democratic political candidates and organizations and non-profit organizations. Clay left the firm in late January 2008, leaving just three founding partners. Blue State Digital was a recipient of the Fast Company magazine's "Fast 50" award in 2006.The company has provided a variety of technology and services to the 2008 Barack Obama presidential campaign, including online fundraising, voter outreach, social networking, and Web hosting.[1] The company is currently being employed in the UK to help in the campaign against the far-right British National Party(BNP) in the 2009 European Parliament elections."[54] See the September/October 2008 issue of the MIT Technology Review report on: How Obama *Really* Did It, The social-networking strategy that took an obscure senator to the doors of the White House. By David Talbot @ https://www.technologyreview.com/web/21222/. And the really interesting thing is that he is also using the social networks to govern. "Campaign insiders suggest privately that Blue State has so impressed Obama that, if he wins in November, the company could be in the unique position to play a role inside the White House."[55] Go to: http://www.whitehouse.gov/. You can also verify Obama's pledge to be transparent and accountable with a 787 billion Act @ http://www.recovery.gov/. "The American Recovery and Reinvestment Act will be carried out with full transparency and accountability -- and Recovery.gov is the centerpiece of that effort. In a short video, President Obama describes the site and talks about how you'll be able to track the Recovery Act's progress every step of the way."

However we must be vigilant because even with the Obama administration the Federal Reserve Bank is still a private institution created with public resources for private interest. A current account of the Fed's secretive behavior was also given in a Democracy Now! Headlines for November 11, 2008. Fed Refuses to List Banks Drawing $2T in Federal Loans: A new controversy has erupted over the Bush administration's refusal to identify banks on the receiving end of almost $2 trillion in taxpayer loans. The Bloomberg news company has sued the Federal Reserve to release a list of borrowing banks and the troubled assets they're putting up as collateral. The Fed says it won't release the list to avoid financial panic. The bank loans have come outside of the $700 billion Wall Street bailout package and don't require congressional approval. The loans were made under the auspices of eleven different government programs. Eight of them have been created in the past fifteen months.[56]

You can also follow up with a report at Democracy Now! For November 17, 2008 by Naomi Klein on the Bailout Profiteers and the Multi-Trillion-Dollar Crime Scene.[57] "The more details emerge, the clearer it becomes that Washington's handling of the Wall Street bailout is not merely incompetent. It is borderline criminal," says Naomi Klein, author of The Shock Doctrine: The Rise of Disaster Capitalism (Paperback) by Naomi Klein. An Amazon reviewer gives us a relevant account of this highly informative book. "The late Milton Friedman, the renowned economist (monetarist), believed that democracy and a free-market economy went hand-in-hand, that the greatest threat to both was nationalization, government regulation, and social spending. He preached this philosophy to his disciples at the University Of Chicago School Of Economics, and they would go forth spreading the Gospel according to the Book of Milton. There is also the International Monetary Fund, an agency founded after World War II to help struggling countries and their economies get back on their feet. Many of its managers and policy makers will be graduates of the Chicago School of Economics, and they will begin to impose the Friedman creed wherever possible. There is only one thing wrong. No population seems to vote in the people who support their brand of economics. Its first success is when a socialist, democratically elected President of Chile, Salvador Allende, is overthrown and killed when the presidential palace is stormed by fascists (9/11/73). Augusto Pinochet comes into power and immediately places the "Chicago boys" in charge of the economy. With the death of price controls and lunch programs, Chileans find themselves spending one quarter of their monthly salaries just to buy bread. They will leave hours earlier for work than usual because they can no longer afford public transportation. Even Chile's social security program, once a model of efficiency is privatized, becoming virtually worthless overnight. Chilean children begin fainting in school from lack of food or milk and many stop attending altogether. The story of Chile will be repeated in Argentina, Bolivia, China, Peru, Poland, South Africa, Sri Lanka, and Russia where the IMF will demand that borrowers meet Draconian conditions before they lend money. In each case these austerity measures will be made overnight, all at once. A shocked population will come to their senses if such radical changes are made over time. They will be able to organize, mobilize and challenge the implementation of such policies. It has to come all at once, right after elections, a coup, or a hurricane when the population will be too dazed and disorganized to respond. This will be the shock, or as author Naomi Klein calls it, shock doctrine.

For those who are still lucid, there is the next step in the shock doctrine, terrorize, torture, or make them disappear. In each case, in each country, prices on food and other common items will go through the roof, the number of destitute will increase exponentially, and democracy will be squashed. In China, the communist elite will impose these changes on the masses while ensuring that they will profit handsomely from the economic and social upheaval. President Clinton will cheer the economic shock doctrine instituted by Boris Yeltsin as he dissolves the Court and the Parliament, bringing the Russian army out to attack the latter, which killed more than 300 people and several deputies. A new class of super mega apparatchiks will emerge increasing the divide between the "have mores" and the "have nothings," and Russians will put up with a few KGB murders and disappearances for the promise of stability that Vladimir Putin will provide. The Polish people, fed up with the broken promises of Solidarity who succumbed to IMF demands to relieve them of their crushing debt, will be thrown out of office in 1996 elections. Nelson Mandela will focus so much on achieving political control of South Africa he will neglect the real political power of controlling the economic engines that run the nation. He

soon discovers that without economic power, he has no political muscle. He becomes a slave of economic apartheid. Shanty towns will get larger and people will become poorer. The population is disillusioned with their new-found "equality."

The tsunami in Sri Lanka will allow the hoteliers to make a deal with the government, and place security guards around the beaches of what once belonged to villagers who fished from there for hundreds of years. After all, what right did they have to be there? The smell of fish made their guests complain. They will be driven inland where they will be given boats and houses, just no access to water to fish. But that could never be allowed to happen here, or could it? One of the first things President George W. Bush does after he finally realizes what happened in New Orleans after Hurricane Katrina is remove union wage scale that contractors would have to pay to laborers. (After all, it is the corporations that must benefit the most from disaster capitalism, not the people of New Orleans). The shock has begun as developers are already seeing how they can take over the utterly destroyed neighborhoods of the poor and turn them into luxury condos and hotels. Charter schools are replacing the public schools and teachers. Contractors will wake up illegal laborers in the night to tell them that the Immigration officers are coming to arrest them. They will run away without having been paid. The Federal Emergency Management Agency, once a functional, effective, national emergency response unit, has had so much work farmed out to contractors, it cannot mount an effective response to the disaster. They will pay top dollar for roofing that can done at a fraction of the cost. They will supply trailers for homeless that are made of material unsafe to breathe, and people will die in a stadium because no one can take care of them.

In Iraq, the local population rose up after our invasion and began to elect their own leaders and councils. They announced plans to take over city governments, services and industry. When Iraqis were asked what they wanted more of when they were surveyed, they clamored for more government jobs, but L. Paul Bremer wasn't about to allow democracy to get in the way of disaster capitalism. He ordered the military to disband all local democratic initiatives, which he replaced with a council not chosen by the Iraqi people, but by him. George Bush talks democracy (in Iraq), but walks capitalism by performing a Marshal Plan in reverse. The original plan implemented right after World War II called for keeping foreign investors out of Germany. Our government wanted the Germans to be able to build up their own industry and wealth. Not so in Iraq. Unemployed and starving Iraqis watched how American contractors brought in cheap Asian labor to rebuild their country. Iraqi unemployment remains at approximately sixty percent. American oil companies and American banks make long-term contracts with the new Iraqi government and the IMF wants Iraq to sell off its own oil industry to foreigners. The second largest military commitment in Iraq, after the Americans, will be mercenaries. Does anyone wonder why there is an insurgency? "No 'capitalization' without representation!"

The author makes it clear. In every country that holds free elections, no one votes for the shock doctrine of disaster capitalism. No one will vote away social programs, controls, or selling off their industries and companies to foreign investors, Klein's conclusion? Capitalism and democracy are not inherently compatible as Friedman always believed. It was just the opposite. This book is powerful and moving. As I reread my review, I feel I have not done her book justice in relating the power and depth of Naomi Klein's words. Her documentation is exceptional. Her ability to craft together different events and present them in a coherent and believable hypothesis is necromantic. Once in a while you find a book, a special book, one you keep as a reference, a "go-to" one. This is such a book. It is one of the two most important I have read for 2008. I have enough admiration for this woman's work that I would buy anything she writes, without hesitation. Her writing will hold your attention. "The Shock Doctrine" is eye-opening and of course, absolutely shocking."[58]

One of the best legal, historical, cultural and psychiatric expose of the corporate institution I have witnessed is: **The Corporation: The Pathological Pursuit of Profit and Power by Joel Bakan, (paperback and DVD format)free @ http://www.thecorporation.com/.** An Amazon reviewer states that "the modern corporation, according to law professor Joel Bakan, is "singularly self-interested and unable to feel genuine concern for others in any context." (p. 56) From this Bakan concludes that the corporation is a "pathological" entity. This is a striking conclusion. The so-called pathological personality in humans is well documented and includes serial killers and others who have no regard for the life and welfare of anyone but themselves. But is it really fair to label the corporation, managed and owned by normal caring and loving people, in this way? Bakan thinks so. He begins with a little history showing how the corporation developed and how it came to occupy the dominate position that it enjoys today. He recalls a time before "limited liability" when shareholders were legally responsible for the actions of the corporation, a time when corporations could not own stock in other companies, a time when corporations could not acquire or merge with other corporations, a time when shareholders could more closely control corporate management. Next he shows what corporations have become, and finally what can be done about it. Bakan's argument includes the point that the corporation's sole reason for being is to enhance the profits and power of the corporation. He shows by citing court cases that it is the duty of management to make money and that any compromise with that duty is dereliction of duty.

Another point is that "corporations are designed to externalize their costs." The corporation is "deliberately programmed, indeed legally compelled, to externalize costs without regard for the harm it may cause to people, communities, and the natural environment. Every cost it can unload onto someone else is a benefit to itself, a direct route to profit." (pp. 72-73) And herein lies the paradox of the corporation. Designed to turn labor and raw materials efficiently into goods and services and to thereby raise our standard of living, it has been a very effective tool for humans to use. On the other hand, because it is blind to anything but its own welfare, the corporation uses humans and the resources of the planet in ways that can be and often are detrimental to people and the environment. Corporations, to put it bluntly, foul the environment with their wastes and will not clean up unless forced to. (Fouling the environment and leaving the mess for somebody else to clean up is exactly what "externalizing costs" is all about.) Furthermore, corporations are amoral toward the law. "Compliance...is a matter of costs and benefits," Bakan writes. (p. 79) He quotes businessman Robert Monks as saying, "...whether corporations obey the law or not is a matter of whether it's cost effective... If the chance of getting caught and the penalty are less than it costs to comply, our people think of it as being just a business decision." (p. 80) The result is a nearly constant bending and breaking of the law. They pay the fine and then break the law again. The corporation, after all, has no

conscience and feels no remorse. Bakan cites 42 "major legal breaches" by General Electric between 1990 and 2001 on pages 75-79 as an example. The fines for malfeasance are usually so small relative to the gain that it's cost effective to break the law. Bakan disagrees with the notion that corporations can be responsible citizens and that corporate managers can act in the public good. He believes that corporations can and sometimes do act in the public interest, but only when that coincides with their interests or because they feel the public relations value of acting in the public interest is greater than the cost of not doing so. He adds "business is all about taking advantage of circumstances. Corporate social responsibility is an oxymoron...as is the related notion that corporations can...be relied upon to promote the public interest." (p. 109)

As for corporations regulating themselves, Bakan writes, "No one would seriously suggest that individuals should regulate themselves, that laws against murder, assault, and theft are unnecessary because people are socially responsible. Yet oddly, we are asked to believe that corporate persons--institutional psychopaths who lack any sense of moral conviction and who have the power and motivation to cause harm and devastation in the world--should be left free to govern themselves." (p. 110) Bakan even argues (and I think he is substantially right) that "Deregulation is really a form of de-democratization" because it takes power away from a government, elected by the people, and gives it to corporations which are elected by nobody. Some of the book is devoted to advertizing by corporations, especially to children, and the effect of such advertizing. Beyond advertizing is pro-corporate and anti-government propaganda. Bakan quotes Noam Chomsky as saying, "One of the reasons why propaganda tries to get you to hate government is because it's the one existing institution in which people can participate to some extent and constrain tyrannical unaccountable power." (p. 152) What to do? Well, for starters, make the fines large enough to change corporate behavior. Make management responsible--criminally if necessary--for the actions of the corporation. Bakan includes these among his remedies on pages 161-164. He also wants the charters of flagrant and persistent violators to be suspended. He writes that corporations are the creations of government and should be subject to governmental control and should NOT (as we often hear) be "partners" with government. He would also like to see elections publically financed and an end to corporate political donations. Indeed if we could take the money out of elections, our representatives would not be beholden to the corporate structure and would act more consistently in the broader public interest. *I think this is one of the most important challenges facing our country today, that of lessening the influence of money on the democratic process*. Bottom line: a seminal book about one of the most important issues facing us today." [59]

Libertarian Socialism as the Core of the Emerging Open Resource Based Economy

The Bible was wrong, it is not the "love of money that is the root of all evil," but the incoherent idea or institution of money and its slave wage that is the root of this pervasive corruption and the real social problem. The inequality or asymmetrical relations between people that result when money is the fundamental system of human exchange for all natural and manufactured resources creates or perpetuates the master-slave structure. To blame the problem on individual love, desire or emotions is to misdirect the issue and leave the social-corporate problem intact. Clear evidence for the destructiveness of money created by business organizations is in the politics of war, crime, poverty, sickness, environmental abuse, greed, and inequality. Most people don't love money for itself but the power and the objects that money can buy; it is the resources–natural, manufactured and human—that we love not its representation. Eliminate the symbolic illusion of wealth created by the manipulators of the money supply and we are forced to confront the reality of the resources which is the real wealth." (See; AGENDA FOR A NEW ECONOMY: FROM PHANTOM WEALTH TO REAL WEALTH by David Korten of YES! Magazine. A Declaration of Independence from Wall Street).[60] Through this face to face encounter with all our human, natural, and manufactured resources we will establish a more coherent and genuine relationship with people, things and ideas. This realization will lead us to a more humane and intelligent management of those resources.

Investigating the Resource-Based-View of an organization Wikipedians asked the fundamental question: "What constitutes a "resource"? Jay Barney[61] referring to Daft[62] says: "...firm resources include all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc; controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness."[63] A subsequent distinction made by Amit & Schoemaker[64] is that the encompassing construct previously called resources can be split up into resources and capabilities. In this respect resources are tradable and non-specific to the firm, while capabilities are firm-specific and used to utilize the resources within the firm, such as implicit processes to transfer knowledge within the firm.[65] This distinction has been widely adopted throughout the resource-based view literature."[66] They answered the foundational question correctly as Peter Drucker often said that "knowledge is the source of wealth" but within the capitalistic or corporate framework that values money more than people and not in the Post Capitalist sense that Drucker meant. "That knowledge has become the resource, rather than a resource, is what makes our society "post-capitalist." -- Post-Capitalist Society p. 45 (1993)… If the feudal knight was the clearest embodiment of society in the early Middle Ages, and the "bourgeois" under Capitalism, the educated person (see section 1.2) will represent society in the post-capitalist society in which knowledge has become the central resource." Post-Capitalist Society (1993). It is my objective throughout this book to answer the fundamental question of those natural and human resources in a libertarian socialist framework and abolish the monetary value system from the resource-based-view of our organizations, ourselves and our planet.

In contrast to the hidden and secretive wheeling and dealing in the background of the state capitalist society, the laser information age is emerging precisely because the laser is now illuminating our collective and individual intelligence in the foreground[67] of a libertarian socialist society on the internet. "Libertarian socialism is an ideology with diverse interpretations, though some general commonalities can be found in its many incarnations. Its proponents advocate for a knowledge worker-oriented system of distribution that radically departs from capitalist economics (socialism).[12] They proposed that this economic system be executed in a manner that attempts to maximize the liberty of individuals and minimize concentration of power or authority (libertarianism). Libertarian

socialists are strongly critical of coercive institutions (the military), which often lead them to reject the legitimacy of the state in favor of anarchism.[13] The term anarchism derives from the Greek □ναρχος, anarchos, meaning "without rulers",[15][16] from the prefix □ν- (an-, "without") + □ρχή (archê, "sovereignty, realm, magistracy")[17] + -ισμός (-ismos, from a stem -ιζειν, -izein). Adherents attempt to achieve this through the decentralization of political and economic power, usually involving the socialization of most large-scale property and enterprise. Libertarian socialism denies the legitimacy of most forms of economically significant private property, because they view capitalist property relations as forms of domination (master-slave system) that are antagonistic to individual and social freedom."[14]68 The knowledge worker in this political-economic system owns the means of production which is his or her brain and favors peer to peer relations.

The Libertarian Socialist group is one of the major advocates for the emergence of the Second SuperPower (global public opinion or the democratic power of the people). I first heard (audio download) of this Second Superpower in Chomsky's Hegemony or Survival: America's Quest for Global Dominance (American Empire Project). But the full political implication of the concept actually came to me via a Democracy Now interview with Venezuelan President Hugo Chavez; "If the Imperialist Government of the White House Dares to Invade Venezuela, the War of 100 Years Will be Unleashed in South America" (September 19, 2005). An excerpt: "The U.S. people have a major role to play to save this planet. Because we're talking about the government. I was reading recently Noam Chomsky, I read him very frequently. And in one of his most recent books, Chomsky, whom I'd like to meet if anything to give him a handshake --and I've been reading him for a while--, says, in a book called Hegemony or Survival (something like what Rosa Luxemburg[69] used to say, "socialism or barbarism:" either we change capitalism, or we're going back to the caveman) that there are two superpowers in this world. I was initially shocked by that idea, but I think he's right after all. And I think the key to save the world might be found there. One superpower is the U.S. government, and its military might --who can deny that?--, its technological power, its space power, its economic power, and so on. But what is the other superpower that could perhaps stop this government? That could even put an end to imperialism so we can have a true democracy to help the peoples of the world? "I believe that the U.S. people is the other superpower that Noam Chomsky is referring to. What is the other superpower? Public opinion. The peoples of the world. That's the other superpower. And the U.S. people have a major responsibility in saving the world. I do think that we're going to save the world. And I hope that you take part in this struggle in the same way we are doing today. And many other people, women and men in this country, in this soil." [70]

A wonderful narrative of the new politics and the emergence of the Second Superpower[71] is clearly stated in the book: Viral Spiral: How the Commoners Built a Digital Republic of Their Own by David Bollier @ http://www.viralspiral.cc/download-book. Amazon Review: There is a transformation taking place in the way people create, organize and think about culture, declares public-policy analyst Bollier (Brand Name Bullies, 2005, etc.). He pins this transformation on the Internet, and particularly on "Web 2.0," which is more focused on conversation and community than its predecessor. Bollier believes that efforts to share software, upload videos and trend to Friendster pages are forging a new commons in the 19th-century sense of the term: a resource shared and managed by all its users.... [T]he author tells a good and important story, one that is likely to gain more relevance as time goes on and Web 2.0 has a greater impact on users' ability to participate in culture. A good book for specialists and advocates.... (Kirkus Reviews 20081115). Product Description: A stunning narrative history of the emergence of electronic "free culture," from open-source software and Creative Commons licenses to remixes and Web 2.0—in the tradition of Lawrence Lessig's Free Culture. A world organized around centralized control, strict intellectual property rights, and hierarchies of credentialed experts is under siege. A radically different order of society based on open access, decentralized creativity, collaborative intelligence, and cheap and easy sharing is ascendant. —from Viral Spiral. From free and open-source software, Creative Commons licenses, Wikipedia, remix music and video mashups, peer production, open science, open education, and open business, the world of digital media has spawned a new "sharing economy" that increasingly competes with entrenched media giants. Reporting from the heart of this "free culture" movement, journalist and activist David Bollier provides the first comprehensive history of the attempt by a global brigade of techies, lawyers, artists, musicians, scientists, business people, innovators, and geeks of all stripes to create a digital republic committed to freedom and innovation. Viral Spiral—the term Bollier coins to describe the almost-magical process by which Internet users can come together to build online commons and tools—brilliantly interweaves the disparate strands of this eclectic movement. The story describes major technological developments and pivotal legal struggles, as well as fascinating profiles of hacker Richard Stallman, copyright scholar Lawrence Lessig, and other colorful figures. A milestone in reporting on the Internet by one of our leading media critics, Viral Spiral is for anyone seeking to take the full measure of the new digital era."[72]

The Second Superpower Rears its Beautiful Head By James F. Moore

@:http://www.extremedemocracy.com/.

"As the United States government becomes more belligerent in using its power in the world, many people are longing for a "second superpower" that can keep the US in check. Indeed, many people desire a superpower that speaks for the interests of planetary society, for long-term well-being, and that encourages broad participation in the democratic process. Where can the world find such a second superpower? No nation or group of nations seems able to play this role, although the European Union sometimes seeks to, working in concert with a variety of institutions in the field of international law, including the United Nations. But even the common might of the European nations is barely a match for the current power of the United States. There is an emerging second superpower, but it is not a nation. Instead, it is a new form of international player, constituted by the "will of the people" in a global social movement. The beautiful but deeply agitated face of this second superpower is the worldwide peace campaign, but the body of the movement is made up of millions of people concerned with a broad agenda that includes social development, environmentalism, health, and human rights. This movement has a surprisingly agile and muscular body of citizen activists who identify their interests

with world society as a whole—and who recognize that at a fundamental level we are all one. These are people who are attempting to take into account the needs and dreams of all 6.3 billion… people in the world—and not just the members of one or another nation. While some of the leaders have become highly visible, what is perhaps most interesting about this global movement is that it is not really directed by visible leaders, but, as we will see, by the collective, emergent action of its millions of participants. Surveys suggest that at least 30 million people in the United States identify themselves this way—approximately 10% of the US population. The percentage in Europe is undoubtedly higher. The global membership in Asia, South America, Africa and India, while much lower in percentage of the total population, is growing quickly with the spread of the Internet. What makes these numbers important is the new cyberspace enabled interconnection among the members. This body has a beautiful mind. Web connections enable a kind of near-instantaneous, mass improvisation of activist initiatives"… An excellent critique and expansion of the Second Superpower article is: Making Room for the Third World in the Second Superpower by Ethan Zuckerman.[73]

In part 1 of this book we will investigate Noam Chomsky's (Linguist-philosopher and professor emeritus at MIT) political knowledge and economic philosophy. There we show and tell that the Wikipedian technology and MIT's open knowledge initiative is truly the language of a libertarian social democracy that is emerging on the World Wide Web.[74] Chomsky stated in a great lecture (Government in the Future) that "classical libertarian thought (Alexander von Humboldt[75] and the Enlightenment[76] thinkers) seems to me, therefore, to lead directly to libertarian socialism or anarchism (defined as freedom to inquire, create and live with the essential equality of conditions as private citizens) if you like, when combined with an understanding of industrial capitalism… Libertarian Socialism reflects the intuitive understanding that democracy is largely a sham when the industrial system is controlled by any form of autocratic elite, whether of owners, managers, and technocrats, a 'vanguard' party, or a State bureaucracy."[77] My objective throughout this book is to inform and educate you about how through the democratic control of the coherent light of lasers we shall overcome the greatest shadow that is being cast over humanity, namely the ruler ship of the Corporatecracy. Corporatecracy is a neologism that describes the US government as an economic empire dominated by a corporate emperor, the Federal Reserve System, the World Bank and the International Monetary Fund headquartered in Washington and its subsidiaries the global private enterprise.[78] Again Chomsky informs us that "the greatest American social philosopher of the twentieth century, John Dewey,[79] once said-correctly I think-that politics is the shadow cast over society by big business. What he meant by that is, as long as you have a massive concentration of private power and wealth, there will essentially be dictatorial systems within the economy. A business firm is basically a dictatorship, with orders coming from top to bottom. As long as those phenomena continue, democracy's going to be very limited. The way to extend democracy is to overcome this massive concentration of power and wealth and to introduce democratic procedures throughout all institutions-what Dewey called going from industrial feudalism[80] to industrial democracy. And not just in industry, but in every other institution. That's a traditional view-Dewey's not a far-out Leftist-and I think it's correct."[81]

From Wikipedia, the free encyclopedia: Industrial democracy

Industrial democracy is an arrangement which involves workers making decisions, sharing responsibility and authority in the workplace. In company law, the term generally used is co-determination, following the German word Mitbestimmung. In Germany half of the supervisory board of directors (which elects management) is elected by the shareholders, and the other half by the workers. Although industrial democracy generally refers to the organization model in which workplaces are run directly by the people who work in them in place of private or state ownership of the means of production, there are also representative forms of industrial democracy. Representative industrial democracy includes decision making structures such as the formation of committees and consultative bodies to facilitate communication between management, unions, and staff.

Benefits of industrial democracy

Advocates often point out that industrial democracy increases productivity and service delivery from a more fully engaged and happier workforce. Other benefits include the following: less industrial dispute resulting from better communication in the workplace; improved and inclusive decision making processes resulting in qualitatively better workplace decisions; decreased stress and increased well-being; an increase in job satisfaction; a reduction in absenteeism; improved sense of fulfillment.

Industrial democracy and revolutionary socialism

In late 19th century and at the beginning of the 20th century industrial democracy, along with anarcho-syndicalism and new unionism, represented one of the dominant tendencies in revolutionary socialism and played a prominent role in international labor movements. While their influence declined after the defeat of the anarchists in the Spanish Revolution in 1939, several unions and organizations advocating industrial democracy continue to exist and are again on the rise internationally. The Industrial Workers of the World advance an industrial unionism which would organize all the workers, regardless of skill, gender or race, into one big union divided into a series of departments corresponding to different industries. The industrial unions would be the embryonic form of future post-capitalist production. Once sufficiently organized, the industrial unions would overthrow capitalism by means of a general strike, and carry on production through worker run enterprises without bosses or the wage system. Anarcho-syndicalist unions, like the Confederación Nacional del Trabajo, are similar in their means and ends but organize workers into geographically based and federated syndicates rather than industrial unions. The New Unionism Network also promotes workplace democracy as a means to linking production and economic democracy.

Representative industrial democracy in modern capitalist economies

Modern industrial economies have adopted several aspects of industrial democracy to improve productivity and as reformist measures against industrial disputes. Often referred to as "teamworking", this form of industrial democracy has been practiced in Scandinavia, Germany, The Netherlands and the UK, as well as in several Japanese companies including Toyota, as an effective alternative to Taylorism. The term is often used synonymously with workplace democracy, in which the traditional master-servant model of employment gives way to a participative, power-sharing model. [82]

For John Dewey, Democracy[83] was a way of life and not just a government system. Education in a democratic society for him was a paramount moral responsibility. Democratic education is not restricted to the school (a subset of the educational growth process) but a continuum of the idea into all institutions of society.[84] I strongly agree with two Amazon.com reviewers that: Democracy and Education by John Dewey is a must read for all students, teachers or parents. "Dewey's classic work, although tedious at times, is a cogent and landmark exposition of progressive educational theory. Democracy for Dewey was both a means and an end to the building of a good and just society. In this regard he sought to develop strategies and methods for training students through learning and discipline to become socially responsible adults and conscientious citizens concerned with the rights of others and the common good and to be equipped with the knowledge and technical skills to be productive members of society in the context of our modern industrial world. Dewey is truly a giant not only of modern educational theory but of progressive humanitarian thought generally."[85]

A second reviewer comments, "perhaps the fact that this great work receives so little attention is indicative of what ails education: educators focus their attention on all the latest drivel concerning education while only paying lip service to Dewey, who remains the highest-ranking educational philosopher. It pains me to hear and read bungling educators mindlessly parrot Dewey's catch phrases (e.g., "learning by doing") while pushing educational doctrines completely antithetical to Dewey's ideas. Dewey had it right, but is grossly misunderstood by the bozos who vapidly regurgitate his words and phrases. In other words, I recommend that you go to the source. If you are in any way concerned with or interested in education and happen to stumble upon this lonely page, do yourself, your kids, and/or your students a favor and study this book carefully; It eclipses all other books on education."[86]

Throughout this book we will be seeing that learning-by-doing is a foundational pedagogical principle for MIT. According to Wikipedia; "Learning-by-doing is a concept of economic theory. It refers to the capability of workers to improve their productivity by regularly repeating the same type of action. The increased productivity is achieved through practice, self-perfection and minor innovations. The concept of learning-by-doing has been used by Kenneth Arrow in his design of endogenous growth theory to explain effects of innovation and technical change. Robert Lucas, Jr. (1988) adopted the concept to explain increasing returns to embodied human capital. Yang and Borland (1991) have shown learning-by-doing plays a role in the evolution of countries to greater specialization in production. In both these cases, learning-by-doing and increasing returns provide an engine for long run growth. Recently, it has become a popular explaining concept in the evolutionary economics and Resource-Based View (RBV) of the firm. Toyota Production System is known for Kaizen that is explicitly built upon learning-by-doing effects." [87]

In contrast to the state capitalist, who are exploiting and appropriating knowledge work productivity for private gain, the libertarian socialist groups are creating for us the democratic equality of conditions and genuine freedom to inquire, create and live through an Open Resource Based Global Economy (ORBE, figure 8) without the selfish corruption of the monetary system. A prototype of the open resource based global economy is currently being built by Jacque Fresco, founder of the Venus Project and his associate Roxanne Meadows. See his wonderful book: The Best That Money Can't Buy: Beyond Politics, Poverty, & War by Jacque Fresco. "THE FUTURE IS FLUID..." Amazon reviewers say, "I must admit that I'm impressed - the book is beautifully produced." -- Arthur C. Clarke, author. "Original and holistic, this book stirs the mind, the heart, and the soul with its combination of vision and pragmatics." -- Dr. Arthur Shostak, Professor of Sociology, Drexel University. "This non-fictional watershed work ... is a prophetic, humanitarian blueprint for a new world." -- Forry Ackerman, author. Jacque Fresco envisions a global civilization in which science and technology are applied with human and environmental concern to secure, protect, and encourage a more humane world for all people. This book offers a possible way out of our recurring cycles of boom and recession, famine, poverty, a declining environment, and territorial conflicts where peace is merely the interval between wars. It outlines an attainable, humane social design of the near future where human rights are no longer paper proclamations but a way of life. The Best That Money Can't Buy is a challenge to all people to work toward a society in which all of the world's resources become the common heritage of all of the earth's people. It is accompanied by 70 color photos of Fresco's original designs, which illuminate the fulfilling lifestyle of a global, resource-based economy.[88]

"Aims and Proposals: It is common in our mass-media to read and to hear commentators talk about the number of social problems that face us today, such as global warming, destruction of Earth's environment, unemployment, crime, violence, poverty, hunger, and the population explosion. Yet, how often do we hear of workable plans for alleviating many of these social problems? It is relatively simple for people to criticize society, however it's much more difficult to identify and implement plans to resolve the problems. The Venus Project is a veritable blue-print for the genesis of a new world civilization, one that is based on human concern and environmental reclamation. The plans for The Venus Project offer society a broader spectrum of choices based on the scientific possibilities directed toward a new era of peace and sustainability for all. Through the implementation of a resource-based economy, and a multitude of innovative and environmentally friendly technologies directly applied to the social system, The Venus Project proposals will dramatically reduce crime, poverty, hunger, homelessness, and many other pressing problems that are common throughout the world today. One of the cornerstones of the organization's findings is the fact that many of the dysfunctional behaviors of today's society stem directly from the dehumanizing environment of a monetary system. In addition, automation has resulted in the technological replacement of human labor by machines and eventually most people will not have the purchasing power to buy the goods and services turned out. The Venus Project proposes a social system in which automation and technology would be intelligently

integrated into an overall social design where the primary function would be to maximize the quality of life rather than profits. This project also introduces a set of workable and practical values. This is in perfect accord with the spiritual aspects and ideals found in most religions throughout the world. What sets The Venus Project apart, however, is that it proposes to translate these ideals into a working reality.

PHASE ONE

The first phase of The Venus Project's long-term plans is already underway. Jacque Fresco, futurist, inventor, industrial designer and founder of The Venus Project and his associate Roxanne Meadows have completed the construction of a 25-acre research center in Venus, Florida to help present the proposals of The Venus Project. Videos, pamphlets, and a recently published book, The Best That Money Can't Buy: Beyond Politics, Poverty, and War, has been created to help raise awareness about this project and its many proposals.

Figure 8. The Venus Project presents a bold, new direction for humanity that entails nothing less than the total redesign of our culture. There are many people today who are concerned with the serious problems that face our modern society: unemployment, violent crime, replacement of humans by technology, over-population and a decline in the Earth's ecosystems. As you will see, The Venus Project is dedicated to confronting all of these problems by actively engaging in the research, development, and application of workable solutions. Through the use of innovative approaches to social awareness, educational incentives, and the consistent application of the best that science and technology can offer directly to the social system, The Venus Project offers a comprehensive plan for social reclamation in which human beings, technology, and nature will be able to coexist in a long-term, sustainable state of dynamic equilibrium. Credit courtesy of http://www.thevenusproject.com/.[89]

PHASE TWO

Phase two includes the production of a full-length feature film that will depict how a world embracing the proposals advanced by The Venus Project would work. This film would provide a positive vision of a peaceful society in which all human beings form a global family on planet Earth. A civilization in which all people are engaged in the pursuit of a better understanding of the world they share. This film has been designed to be an entertaining and educational experience for both adults and children.

PHASE THREE

To test its designs and proposals The Venus Project is working towards putting its ideals into practice by the construction of an experimental research city. Blueprints for most of the initial technologies and buildings have begun. Fund-raising efforts are currently under way to help support the construction of this first experimental city. This new experimental research city would be devoted to working towards the aims and goals of The Venus Project, which are:

1. Realizing the declaration of the world's resources as being the common heritage of all Earth's people.

2. Transcending the need for the artificial boundaries that separate people.

3. Outgrowing monetary-based, nationalistic economies with a resource-based world economy.

4. Assisting in stabilizing the world's population through education and voluntary birth control.

5. Reclaiming and restoring the natural environment to the best of our ability.

6. Redesigning our cities, transportation systems, agricultural industries and industrial plants so that they are energy efficient, clean, and able to conveniently serve the needs of all people.

7. Sharing and applying new technologies for the benefit of all nations.

8. Developing and using clean, renewable energy sources.

9. Manufacturing the highest quality products for the benefit of the world's people.

10. Requiring environmental impact studies prior to construction of any mega projects.

11. Encouraging the widest range of creativity and incentive toward constructive endeavor.

12. Outgrowing nationalism, bigotry and prejudice through education.

13. Outgrowing any type of elitism, technical or otherwise.

14. Arriving at methodologies by careful research, rather than random opinions.

15. Enhancing communication in schools so that our language is relevant to the physical conditions of the world.

16. Providing not only the necessities of life, but also offering challenges that stimulate the mind while emphasizing individuality rather than uniformity.

17. Finally, preparing people intellectually and emotionally for the changes and challenges that lie ahead.

PHASE FOUR

After the research experimental city is built, a theme park is also planned that will both entertain and inform visitors about the possibilities for humane and environmentally friendly life-styles planned by The Venus Project. It will feature intelligent houses; high-efficiency, non polluting transportation systems; advanced computer technology; and a number of other innovations that can add value to the lives of all people - in a very short period of time. No one can actually predict the future. We can only extrapolate on present information and trends. Population growth, technological change, worldwide environmental conditions, and available resources are the primary criteria for future projections. There is no single philosophy or point of view whether religious, political, scientific, or ideological, that someone would not take issue with. We feel certain, however, that the only aspects of The Venus Project that may appear threatening are those which others project onto it. The Venus Project is neither Utopian nor Orwellian, nor does it reflect the dreams of impractical idealists. Instead, it presents attainable goals requiring only the intelligent application of what we already know. The only limitations are those which we impose upon ourselves. We encourage you to become better informed about the proposals of this project through our books, videos and seminars. If you identify with this direction, we welcome you to join with us and work towards its realization. See our photo gallery to view our proposed cities." [90]

One of the main objectives of this book is to transform, convert or transduce the resource-based view (RBV) of capitalism—a monetary tool used to determine the strategic resources available to a corporation—into what "Jacque Fresco (an industrial engineer, architectural designer, social engineer and futurist based in Venus Florida) calls the concept of a 'resource-based economy' that replaces the need for the scarcity-oriented monetary economy we have now. Fresco argues that the world is rich in natural resources and energy and that —with modern technology and judicious efficiency— the needs of the global population can be met with abundance, while at the same time removing the current limitations of what is deemed possible due to notions of economic viability. He states that what is mostly needed today is "a way of intelligently managing the Earth's resources for everyone's well-being."[91] He gives this example to help explain the idea: At the beginning of World War II the US had a mere 600 or so first-class fighting aircraft. We rapidly overcame this short supply by turning out more than 90,000 planes a year. The question at the start of World War II was: Do we have enough funds to produce the required implements of war? The answer was No, we did not have enough money, nor did we have enough gold; but we did have more than enough resources. It was the available resources that enabled the US to achieve the high production and efficiency required to win the war. Unfortunately this is only considered in times of war. Fresco states that for this to work all of the Earth's resources must be held as the common heritage of all people and not just a select few; and the practice of rationing resources through monetary methods are irrelevant and counterproductive to our survival."

Figure 9.Coherent Circular cities that think, The Venus Project proposes a city that would use the most sophisticated available resources and construction techniques. Its geometrically elegant and efficient circular arrangement will be surrounded by, and incorporated into the city design, parks and lovely gardens. The city will be designed to operate with the minimum expenditure of energy using the cleanest technology available, which will be in harmony with nature to obtain the highest possible standard of living for everyone. Credit Courtesy of Wikipedia and TVP.

According to the Venus Project website "A Resource-Based Economy is a system in which all goods and services are available without the use of money, credits, barter or any other system of debt or servitude. All resources become the common heritage of all of the inhabitants, not just a select few. The premise upon which this system is based is that the Earth is abundant with plentiful resource; our practice of rationing resources through monetary methods is irrelevant and counterproductive to our survival.

Modern society has access to highly advanced technology and can make available food, clothing, housing and medical care; update our educational system; and develop a limitless supply of renewable, non-contaminating energy. By supplying an efficiently designed economy, everyone can enjoy a very high standard of living with all of the amenities of a high technological society. A resource-based economy would utilize existing resources from the land and sea, physical equipment, industrial plants, etc. to enhance the lives of the total population. In an economy based on resources rather than money, we could easily produce all of the necessities of life and provide a high standard of living for all... All social systems, regardless of political philosophy, religious beliefs, or social customs, ultimately depend upon natural resources, e.g. clean air and water, arable land, and the necessary technology and personnel to maintain a high standard of living. This can be accomplished through the intelligent and humane application of science and technology. The real wealth of any nation lies in its developed and potential resources and the people who are working toward the elimination of scarcity and the development of a more humane way of life. A resource-based economy would use technology to overcome scarce resources by utilizing renewable sources of energy; computerizing and automating manufacturing, inventory and distribution; designing safe, energy-efficient cities; providing universal health care and relevant education; and most of all, by generating a new incentive system based on human and environmental concern."[92]

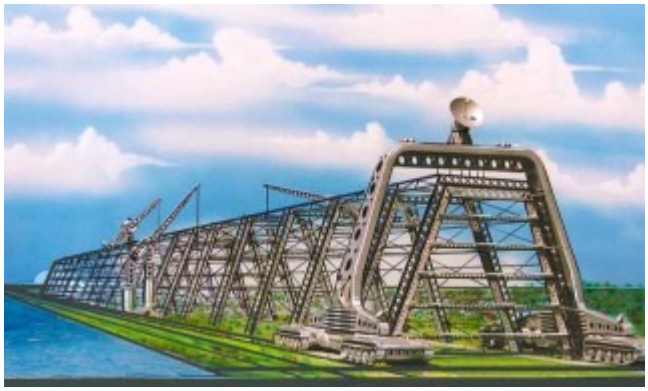

Figure10. Automated construction for The Venus Project. The construction of these industrial and research complexes in the Circular City can be carried out by robotic equipment that will receive instructions via satellite. Automated cranes travel along the buildings' length installing floors, windows, curtain walls, roofing, and other components from the ground up. These devices will contain sensors to minimize industrial accidents or collisions with other devices or living beings. Credit Courtesy of Wikipedia and TVP.

Figure 11.**Laser Excavator.** This scene depicts a laser excavator of the future. Such devices, which could be directed via satellite, would be capable of fusing the earth beneath it into a molten magma-like material. This machine would be able to change its shape to conform to a wide range of contours such as canals, roads, and waterways. Credit courtesy of TVP

For me the best introduction to the resource-based economy and the fundamental selfish problem of capitalism—as the root cause of ignorance (restriction of resources for poor public schools), poverty (slave wage labor), disease (hijacked medicine) and crime (class war due to inequality)—is narrated and illustrated in the "Zeitgeist: Addendum, a 2008 documentary film produced by Peter Joseph. This video is a continuation of the film Zeitgeist, the Movie.[1] The film includes conspiracy theories regarding the Federal Reserve System in the United States, the CIA, corporate America and others, concluding with the advocating of the Venus Project, created by social engineer Jacque Fresco. The movie premiered at the 5th Annual Artivist Film Festival in Los Angeles, California on October 2, 2008, and was released free online on October 4, 2008.[2] According to director Peter Joseph, the film "attempts to locate the root causes of this pervasive social corruption, while offering a solution".[3] In conclusion, Addendum stresses the need for belief systems to embrace the ideas of emergence and interdependence and outlines concrete steps that can be taken to weaken and abolish the monetary system.

Since for me the coherent medium of the laser is the central message of this age, I subscribe wholeheartedly to the Zeitgeist Movement's stated Goal: 'The Means is the End: We intend to restore the fundamental necessities and environmental awareness of the species through the avocation of the most current understandings of who and what we truly are, coupled with how science, nature and technology (rather than religion, politics and money) hold the keys to our personal growth, not only as individual human beings, but as a civilization, both structurally and spiritually. The central insights of this awareness is the recognition of the Emergent and Symbiotic elements of natural law and how aligning with these understandings as the bedrock of our personal and social institutions, life on earth can and will flourish into a system which will continuously grow in a positive way, where negative social consequences, such as social stratification, war, biases, elitism and criminal activity will be constantly reduced and, idealistically, eventually become nonexistent within the spectrum of human behavior itself." Zeitgeist (pronounced [□t□sa□tga□st]) is a German language expression literally translated: Zeit, time; Geist, spirit, meaning "the spirit of the age and its society". The word zeitgeist describes the intellectual, cultural, ethical and political climate of an era or also a trend."[93]

The Laser Information Age will collectively illuminate the human brain with the VRD and other Laser Displays in the foreground of the Knowledge Society and the Society of Organizations. These societies will be empowered by LaserFusion-Fission power sources and Laser Drilled Geo-thermal sources via Fiber and Free Space Optics and the Atomic Laser from the Bose- Einstein Condensate as background technologies.

Since the main theme of this book is the Laser Information Age and due to the universality of the term information, it will therefore be used in its comprehensive scientific sense as organized data on the computer side and knowledge as interpreted information on the human side. Because Knowledge is invented or created inside the human brain, so this book will be based on Drucker's idea of knowledge management practice as a Liberal Art (see the Laser Informed Learner's Strengthsquest in section 1.2 on The Educated Person). And because of the rigorous laser science that supports engineering, this interpretation is also based on the Scientific method. According to Wikipedia, "the Scientific method refers to bodies of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge. To be termed scientific, a method of inquiry must be based on gathering observable, empirical and measurable evidence subject to specific principles of reasoning.[1] A scientific method consists of the collection of data through observation and experimentation, and the formulation and testing of hypotheses.[2]

Although procedures vary from one field of inquiry to another, identifiable features distinguish scientific inquiry from other methodologies of knowledge. Scientific researchers propose hypotheses as explanations of phenomena, and design experimental studies to test these hypotheses. These steps must be repeatable in order to dependably predict any future results. Theories that encompass wider domains of inquiry may bind many hypotheses together in a coherent structure. This in turn may help form new hypotheses or place groups of hypotheses into context. Among other facets shared by the various fields of inquiry is the conviction that the process be objective to reduce a biased interpretation of the results. Another basic expectation is to document, archive and share all data and methodology so they are available for careful scrutiny by other scientists, thereby allowing other researchers the opportunity to verify results by attempting to reproduce them. This practice, called full disclosure, also allows statistical measures of the reliability

of these data to be established.[94]

According to Wikipedia, "this Information Age (also known as the Digital Age and Wireless Age) is a term that alludes to the global economy's shift in focus away from the production of physical goods (as exemplified by the industrial age) and toward the manipulation of information."[95] Again Wikipedia continues to inform us that: "Information as a concept bears a diversity of meanings, from everyday usage to technical settings. Generally speaking, the concept of information is closely related to notions of constraint, communication, control, data, form, instruction, knowledge, meaning, mental stimulus, pattern, perception, and representation. Many people speak about the Information Age as the advent of the Knowledge Age or knowledge society, the information society, the Information revolution, and information technologies, and even though informatics, information science and computer science are often in the spotlight, the word "information" is often used without careful consideration of the various meanings it has acquired."[96]

According to Peter Drucker in Wikiquote; The information revolution. Almost everybody is sure ...that it is proceeding with unprecedented speed; and ...that its effects will be more radical than anything that has gone before. Wrong, and wrong again. Both in its speed and its impact, the information revolution uncannily resembles its two predecessors ...The first industrial revolution, triggered by James Watt's improved steam engine in the mid-1770s...did not produce many social and economic changes until the invention of the railroad in 1829 ...Similarly, the invention of the computer in the mid-1940s, ...it was not until 40 years later, with the spread of the Internet in the 1990s, that the information revolution began to bring about big economic and social changes. ...the same emergence of the "super-rich" of their day, characterized both the first and the second industrial revolutions. ...These parallels are close and striking enough to make it almost certain that, as in the earlier industrial revolutions, the main effects of the information revolution on the next society still lie ahead. -- "The way ahead" Economist.com (November 2001). This new knowledge economy will rely heavily on knowledge workers. ...the most striking growth will be in "knowledge technologists:" computer technicians, software designers, analysts in clinical labs, manufacturing technologists, paralegals. ...They are not, as a rule, much better paid than traditional skilled workers, but they see themselves as "professionals." Just as unskilled manual workers in manufacturing were the dominant social and political force in the 20th century, knowledge technologists are likely to become the dominant social—-and perhaps also political—-force over the next decades. -- "The next society" Economist.com (November 2001)

In a more technical sense information in this book is in the MIT tradition of Cybernetics (steersman or governor) a term invented by Professor Norbert Weiner to emphasize the interdisciplinary nature of the theory of messages or control and communication in the human and the machine. In his classic book: The Human Use of Human Beings, Cybernetics and Society, Dr. Wiener summarizes his seminal thoughts about information. "It is the purpose of Cybernetics to develop a language and techniques that will enable us indeed to attack the problem of control and communication in general, but also to find the proper repertory of ideas and techniques to classify their particular manifestations under certain concepts. The commands through which we exercise our control over our environment are a kind of information we impart to it… Like any form of information, these commands are subject to disorganization in transit. They generally come through in less coherent fashion and certainly not more coherently than they were sent. In control and communication we are always fighting nature's tendency to degrade the organized and to destroy the meaningful; the tendency, as Gibbs has shown us, for entropy to increase… Just as entropy tends to increase spontaneously in a closed system, so information tends to decrease; just as entropy is a measure of disorder, so information is a measure of order… Information is a name for the content of what is exchanged with the outer world as we adjust to it, and make our adjustments felt upon it. The process of receiving and of using information is the process of our adjusting to the contingencies of the outer environment, and our living effectively within that environment. The needs and the complexity of modern life make greater demands on this process of information than ever before, and our press, our museums, our scientific laboratories, our universities, our libraries and textbooks, are obliged to meet the needs of this process or fail in their purpose. To live effectively is to live with adequate information. Thus, communication and control belong to the essence of man's inner life, even as they belong to his life in society." According to Wikipedia, Norbert Wiener (November 26, 1894, Columbia, Missouri – March 18, 1964, Stockholm, Sweden) was an American theoretical and applied mathematician. Wiener was a pioneer in the study of stochastic and noise processes, contributing work relevant to electronic engineering, electronic communication, and control systems. Wiener also founded cybernetics, a field that formalizes the notion of feedback and has implications for engineering, systems control, computer science, biology, philosophy, and the organization of society. [97]

More specifically, we will also be seeing information in the laser wave sense as an energy (signal) exchange or transfer throughout all systems of communications and control. Since the computer excels at data organization and the human brain excels at visualization, interpretation and the conceptualization of information, I fused both through the most advanced human/computer laser interface (Virtual Retinal Display) available to date. For a profound inquiry into how nature, the computer and humanity organize itself (self-organization) via emergent collective phenomena throughout the whole spectrum of science or the society of knowledge and the society of organizations, I used Wikipedia, Peter Drucker's management principles and practices and the book: A Different Universe, Re-Inventing Physics from the Bottom Down by Robert B. Laughlin. The author is an MIT graduate and professor at Stanford, he is also the winner of the 1998 Nobel Prize in Physics for his mathematization of the Quantum Hall Effect. According to Wikipedia; "the fractional quantum Hall effect (FQHE) is a manifestation of simple collective behavior in a two-dimensional system of strongly interacting electrons. At particular magnetic fields, the electron gas condenses into a coherent state with liquid-like properties. This property is called superfluidity, a phase of matter achieved by a few cryogenic liquids at extreme temperature where they become able to flow without friction. A superfluid can flow up the side of an open container and down the outside. Placing a superfluid in a spinning container will result in quantized vortices(see Bose-Einstein condensate and a comprehensive list of the different states of matter).

In the physical sciences, a phase is a set of states of a macroscopic physical system that have relatively uniform chemical composition and physical properties (i.e. density, crystal structure, index of refraction, and so forth). Phases are sometimes confused

with states of matter, but there are significant differences. States of matter refers to the differences between gases, liquids, solids, plasma, etc. If there are two regions in chemical systems that are in different states of matter, then they must be different phases. However, the reverse is not true — a system can have multiple phases which are in equilibrium with each other and also in the same state of matter." [98] In this book Dr Laughlin, shows with lucid understanding how nature converts imperfection or incoherence into perfection (coherence figure 12). This view of the universe shows how higher level (macroscopic) organizational laws emerge from low level (microscopic) universal laws of physics (the constants) and how the macro scale makes the micro scale irrelevant.[99] For this emergent worldview, the organizational principle[100] of matter/energy/information is more fundamental than the reductionist worldview of fundamental physics, for which atomic processes are the foundation of reality.[101]

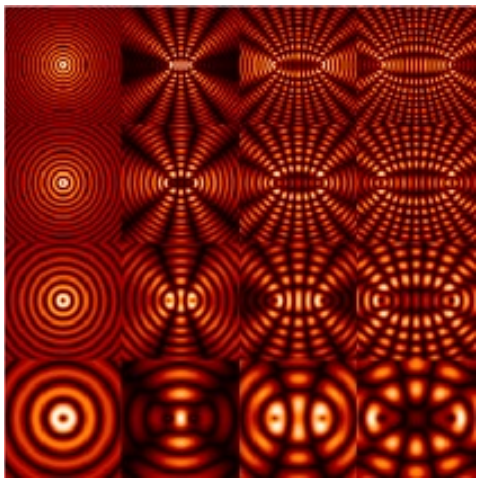

Figure 12. Coherence is the property of wave-like states that enables them to exhibit interference of two circular waves -Interference is the addition (superposition) of two or more waves that result in a new wave pattern. As most commonly used, the term interference usually refers to the interaction of waves which are correlated or coherent with each other, either because they come from the same source or because they have the same or nearly the same frequency. Two non-monochromatic waves are only fully coherent with each other if they both have exactly the same range of wavelengths and the same phase differences at each of the constituent wavelengths. The total phase difference is derived from the sum of both the path difference and the initial phase difference (if the waves are generated from 2 or more different sources). It can then be concluded whether the waves reaching a point are in phase (constructive interference) or out of phase (destructive interference). Credit: courtesy of Wikipedia.[102]

Wikipedia gives us a clear example of the organizational principle or coherent state as it applies to the laser. "A LASER (acronym for "light amplification by stimulated emission of radiation") can also be characterized as a self organized system to the extent that normal states of thermal equilibrium characterized by electromagnetic energy absorption are stimulated out of equilibrium in a reverse of the absorption process. "If the matter can be forced out of thermal equilibrium to a sufficient degree, so that the upper state has a higher population than the lower state (population inversion), then more stimulated emission than absorption occurs, leading to coherent growth (amplification or gain) of the electromagnetic wave at the transition frequency (see section 2.4)… [4][103] In quantum mechanics a coherent state (figure 12) is a specific kind of quantum state of the quantum harmonic oscillator whose dynamics most closely resemble the oscillating behavior of a classical harmonic oscillator system. It was the first example of quantum dynamics when Erwin Schrödinger derived it in 1926 while searching for solutions of the Schrödinger equation that satisfy the correspondence principle. The quantum harmonic oscillator and hence, the coherent state, arise in the quantum theory of a wide range of physical systems. For instance, a coherent state describes the oscillating motion of the particle in a quadratic potential well. In the quantum theory of light (quantum electrodynamics) and other bosonic quantum field theories they were introduced by the work of Roy J. Glauber in 1963. Here the coherent state of a field describes an oscillating field, the closest quantum state to a classical sinusoidal wave such as a continuous laser wave (figure 13)."[104]

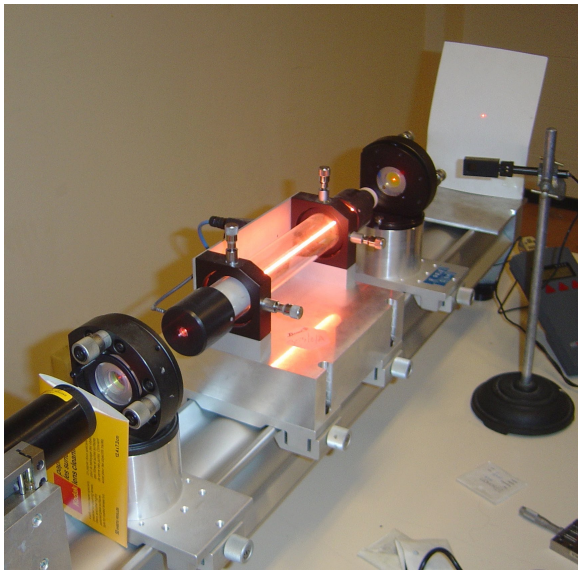

Figure13. A helium-neon laser demonstration at the Kastler-Brossel Laboratory at Univ. Paris 6. The glowing ray in the middle is an electric discharge producing light in much the same way as a neon light. It is the gain medium through which the laser passes, not the laser beam itself, which is visible there. The laser beam crosses the air and marks a red point on the screen to the right. The HeNe laser was the first gas laser to be invented, by Ali Javan, William Bennett Jr. and Donald Herriott at Bell Labs, who in 1960 achieved continuous wave emission of the laser on the 1.15 μm wavelength line[7][105] Credit; courtesy of Wikipedia

In Schrödinger's Universe: Einstein, Waves and the Origin of the Natural Law by Milo Wolff, I found that: "Erwin Schrodinger (1937) perceived that the whole Universe, what we observe as material bodies and forces, are nothing but shapes and variations in the structure of space. When he and Einstein debated the particle theorists led by Neils Bohr, most scientists thought they had lost it. This book shows they were right; that all matter is one Wave Structure in the space of the Universe. If the stars did not exist, we could not exist (the Mach principle integrated in Einstein's theory of General Relativity)… Schrödinger's Universe is Dr. Wolff's second book on the Wave Structure of Matter, a theory that shows a different formulation for the structure of matter and the universe. This book approaches the explanation of the wave structure in a new way from his last book; he starts from the basics, but he also covers the new material from the 20 years between his two books. It is very readable and easily understandable to non-physicists, plus it provides appendices to show the math that validates the theory to physicists. This theory provides a better way of looking at the universe: It removes the need for a wave-particle duality, it explains the bases for the natural laws of physics, it provides a satisfying philosophical perspective to tie it to the math and physics, it solves Schrödinger's and Einstein's issues with the probability interpretation of Quantum Theory, and it shows a way to avoid many of the paradoxes and inconsistencies in modern physics simply by rethinking the nature of the electron and its role in the universe." I highly recommend this incredible book, and I agree with another reviewer "that this book is going to be the basis for the next generation of physicists."[106]

The seed idea for my understanding of the wave structure of matter (WSM) as collective emergent phenomenon and self-organization in the laser was implanted in my brain with the reading of Collective Electrodynamics: Quantum Foundations of Electromagnetism by Carver A. Mead. "In this book Carver Mead offers a radically new approach to the standard problems of electromagnetic theory. Motivated by the belief that the goal of scientific research should be the simplification and unification of knowledge, he describes a new way of doing electrodynamics--collective electrodynamics--that does not rely on Maxwell's equations, but rather uses the quantum nature of matter as its sole basis. Collective electrodynamics is a way of looking at how electrons interact, based on experiments that tell us about the electrons directly (As Mead points out, Maxwell had no access to these experiments)."[107] Amazon Review: Bohr and Heisenberg Refuted, November 22, 2007 by W. D. Moore "As of today, Thanksgiving, 22November2007, there are ten reviews of this book posted. None of them, nor all of them together, is adequate. I urge prospective buyers to read the American Spectator interview with Carver Mead. The Spectator has taken down its copy, but a few are still available online. Google "Carver Mead Collective Electrodynamics Spectator Interview", without quotation marks. One reviewer says here that Mead's arguments against Bohr and Heisenberg were advanced during the 1930's, and were refuted. I wonder if he understands anything anyone has said.

The Spectator writes, "Central to Mead's rescue project are a series of discoveries inconsistent with the prevailing conceptions of quantum mechanics. One was the laser. As late as 1956, Bohr and Von Neumann, the paragons of quantum theory, arrived at the Columbia laboratories of Charles Townes, who was in the process of describing his invention. With the transistor, the laser is one of the most important inventions of the twentieth century. Designed into every CD player and long distance telephone connection, lasers today are manufactured by the billions. At the heart of laser action is perfect alignment of the crests and troughs of myriad waves of light. Their location and momentum must be theoretically knowable. But this violates the holiest canon of Copenhagen theory: Heisenberg Uncertainty. Bohr and Von Neumann proved to be true believers in Heisenberg's rule. Both denied that the laser was possible. When Townes showed them one in operation, they retreated artfully. "In Collective Electrodynamics, Mead cites nine other experimental discoveries, from superconductive currents to masers, to Bose-Einstein condensates predicted by Einstein but not demonstrated until 1995. These discoveries of large-scale, coherent quantum phenomena all occurred after Bohr's triumph over Einstein." When all the waves of all the atoms in a system are synchronized, the system is coherent. Scientists during the 1930's were

not able to synchronize the waves. When all atoms are synchronized, matter is a wave. Mead proves this by experiment. When the waves are not synchronized, they interfere with each other. Perhaps it is true, what some reviewers say here, that Mead does not really develop a complete theory of electrodynamics; but he does demonstrate conclusively from actual experiments his main contention: Bohr taught the correspondence principle, which says that as quantum numbers get large, the behavior approximates a Newtonian mechanical system. But modern experiments show that as quantum numbers get large, behavior diverges more and more from a mechanical system. What large quantum numbers develop into is an electrodynamical system. Under that paradigm, if the system is coherent, Mead has a perfect solution to Schrodinger's wave equation; and the uncertainty principle disappears."

Dr. Mead taught me that 'science is all in how you look at things" and it was precisely in the summer of 2000 that my discovery of the Collective Electrodynamics[108] theory of the laser coincided with my finding of the Microvision Virtual Retinal Display (VRD), an augmented reality (AR) color and monochrome eyewear along with other laser display technologies (figure 14). This breakthrough informed my visual education and made it actual or practical, now I had a new theory and a new praxis. According to Ben Averch a global product manager of Wearable Displays with Microvision, "augmented reality (AR) is the intersection of the real world and digital information. An important aspect of AR is that by definition it is the superimposition of digital images and characters onto the regular environment. This requires a see-through, high-brightness color display. We believe that augmented reality will emerge as the next step in the evolution of the mobile internet – and that we are optimally positioned to enable this nascent transformation with our eyewear display platform." In the 1990's American taxpayers[109] via the National Science Foundation (NSF)[110] publically funded the research and development of the Virtual Retinal Display. The VRD is a laser device that converts the human visual system into a computer screen. The research was conducted by Dr. Thomas A. Furnace III (figure 15) and his collaborators at the Human Interface Lab of the University of Washington in Seattle Washington USA.[111] This university group in turn invented and transferred (licensed) the intellectual property value of the VRD to the Microvision Corporation for commercialization. Thanks to the NSF public grant and with further funding by the military, Microvision brought to fruition the most important human/computer interface in history. Through this creative act they provided the most powerful platform for the advancement of visual education, mass collaboration and global participation in the collective intelligence of the internet

Figure 14.An open augmented reality web, based on a free/open resource based economy is an environment that includes both virtual reality and real-world elements.[112] For instance, an AR user might wear translucent goggles; through these, he could see the real world, as well as computer-generated images projected on top of that world.[113] Credit: courtesy of Microvision.[114]

See: Virtual Environments and Advanced Interface Design (Hardcover) by Woodrow Barfield (Editor), Thomas A. Furness (Editor). Review "Fourteen chapters, each written by different authors and covering different topics related to virtual environments, make up this book. Despite the authors' different styles, the content hangs together remarkably well, and it becomes apparent that there is a wealth of information in this book. The book is divided into three sections: an introductory section of two chapters presents a history and overview of the field; a technology section of nine chapters contains the bulk of the material; and a final section contains two chapters relating to psychology and one relating to augmented-reality displays ... This work is a must-have reference for anyone entering the field. It presents enough depth to help readers understand each topic while providing sufficient reference material to permit them to delve further."--Computing Reviews. This sweeping introduction to the science of virtual environment technology masterfully integrates research and practical applications culled from a range of disciplines, including psychology, engineering, and computer science. With contributions from the field's foremost researchers and theorists, the book focuses in particular on how virtual technology and interface design can better accommodate human cognitive, motor, and perceptual capabilities. Throughout, it brings the reader up-to-date with the latest design strategies and cutting-edge virtual environments, and points to promising avenues for future development. The book is divided into three parts. The first part introduces the reader to the subject by defining basic terms, identifying key components of the virtual environment, and reviewing the origins and elements of virtual environments. The second part focuses of current technologies used to present visual, auditory, tactile, and kinesthetic information. The book concludes with an in-depth analysis of how environments and human perception are integrated to create effective virtual systems. Comprehensive and splendidly written, Virtual Environments and Advanced Interface Design will be the "bible" on the subject for years to come. Students and researchers in computer science, psychology, and cognitive science will all want to have a copy on their shelves.[115]

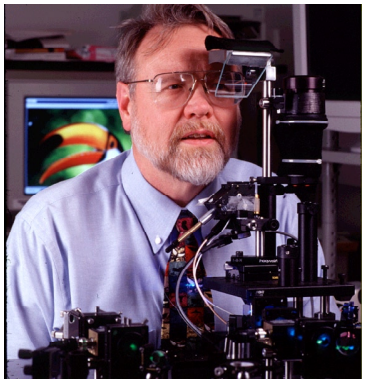

Figure15.Dr. Thomas A. Furness III and the optical bench configuration of the virtual retinal display. “Tightly-coupled human interface technology will produce a symbiotic relationship, supporting and facilitating reflective and experiential thought. Emotional and motivational factors will prove to be as important as cognitive factors in many domains, and natural human behavior will be the predominant mode of interaction. Future media will be personal, flexible, emergent, and universal.” Credit courtesy of the Human Interface Laboratory of the University of Washington.[116]

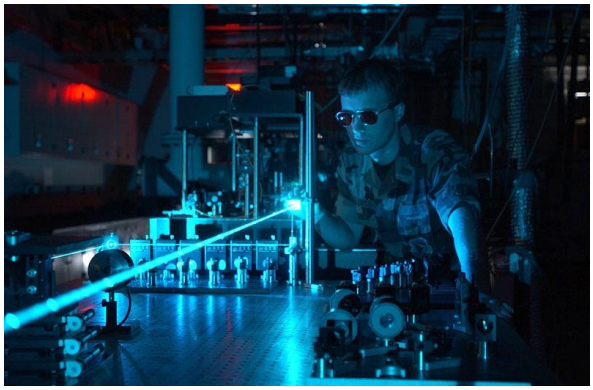

Figure16.A military scientist operates an argon ion laser in a test environment. The Directorate conducts research on a variety of solid-state and chemical lasers.” The term “laser” is an acronym for Light Amplification by Stimulated Emission of Radiation.[1][2] A typical laser emits light in a narrow, low-divergence monochromatic (single-colored, if the laser is operating in the visible spectrum) beam with a well-defined wavelength. In this way, laser light is in contrast to a light source such as the incandescent light bulb, which emits light over a wide area and over a wide spectrum of wavelengths. Credit: courtesy of Wikipedia. [117]

In part 3 of this book, I will show you that just like Einstein, your mind’s ability to focus, concentrate, visualize and create will be augmented by the properties of laser light that he uncovered. I will also show you how all the major cognitive and emotional functions of your brain; attention, memory, language, imagination, visual acuity or focus, reasoning (the executive function) and the amygdale or emotional brain[118] are augmented and corrected with the VRD. I also address the fundamental cognitive problem of attention, concentration and awareness due to incoherency. Microvision’s laser displays expands your situational awareness, enabling the super-empowerment of your consciousness within the immediate environment. Laser cognition correction emerges as a VRD based solution to the ineffective knowledge integration of your brain due to distraction, diffusion and misinformation. Here we investigate the technological, physiological, psychological and sociological structure and function of a coherent global brain. Here we also study the interaction between the laser and the human visual cortex or the visual cognition system. Just as Doctors with laser vision correction[119] have learned to cure the maladies of the physical eyes, the virtual retinal display applied to laser cognition correction is now emerging as the cure for our mind’s eye. Here we show how the coupling of our visual intelligence to Prof. Paul Thagard’s coherence theory of cognition[120] is now upon us and how you can apply this new laser power to higher education. Prof. Thagard through his course on cognition and critical thinking helps us to evaluate what we believe and what we do?[121]

Figure 17. A presenter is illuminated by the VRD and his audience by the laser pico projector. Mobile Device Eyewear Private, Informed, Connected, Don't remember your next slide? Running behind schedule? Master your presentation delivery with Mobile Device Eyewear. Wow your crowd with notes secretly tucked away in your eyeglasses. How would you use Mobile Device Eyewear? Credit: Courtesy of Microvision.

You will also be seeing the emergence of what Dr. David Nolte calls laser intelligence or the empowerment of the visual cortex via the transmission of laser information and the transduction of the visual cortex into a neurocomputational display. The primary aim is to understand this coupling of the VRD to Dr. Nolte's Mind @ Light Speed.[122] According to an Amazon reviewer, "Mind at Light Speed: A New Kind of Intelligence by David D. Nolte is his outline of the future of computing, including all-optical components "reading" pictures as instruction sets millions of times faster than linear, language-based programs. Someday, Nolte writes, "luminous machines of light made from threads of glass and brilliantly colored crystals that glow and shimmer, pulsating to the beat of intelligence" will be commonplace. In other words, clunky electronics that rely on electrons to regulate the flow of information will be replaced by fiber optics that use laser beams to regulate other information-encoded laser beams. But with this generation of machines already at hand, Nolte envisions a further departure: a computer's "consciousness" will be driven by quantum physics. Light computers will use the qubit, the quantum version of the binary bit, to process all answers to a question simultaneously, and could use holographic symbols rather than binary systems as units of information. Nolte supports his case with a broad foundation of argument that includes chapters drawing together the history of quantum physics, the mechanics of human sight and intelligence, linguistics and semiotics.[123] He also gives compelling insights into the nature of human thought and the technology that, he says, could far exceed it.[124] And so through this visual/verbal and moral book I inform, educate and guide individuals and groups who are seeking the best possible way to achieve optimal cognitive performance through scientific visualization. I also direct you to what you need to do to effectively integrate this new laser intelligence into your home (photonic powerlines) or public life (Mobile Head Up Displays on figure 18).

Figure18. Microvision is working with automotive suppliers to develop and bring to market an automotive laser head-up display (HUD). Microvision provides a scanning engine subsystem, based on the PicoP display engine. The scanning engine subsystem may be integrated by Tier I suppliers into a HUD product package suitable for automotive manufacturers. Microvision's automotive grade PicoP display engine offers HUD designers the ability to produce high quality images with high contrast and brightness that are day or night readable. Credit Courtesy of Microvision.[125]

My main goal is to show you how to effectively integrate this new laser intelligence into your living activity, educate your visual cognition and prepare you for participation in the Laser Informed World via the MIT Open Courseware program, the Virtual University and the ORBE.[126] The Virtual Retinal Display served as a tutorial for my laser informed mission of integrating the infinite bandwidth of the Lambdasphere (the all-optical laser internet) directly unto our eyes. Microvision made me aware of how the coherent light of nature can be directly inserted into our visual system. A technical illustration of the triumphant optical powers that laser sources are bringing to our eyes can be seen at http://www.mvis.com/. Here I show you why Microvision's VRD is the most efficient way of maximizing the input, assimilation, comprehension and retention of information as well as its subsequent use and conversion into knowledge and wisdom.

It is my understanding that with the proper translation of scientific knowledge into best practices and its integration into your moral sense, laser information can lead you to wisdom. According to Marc Hauser we have an innate moral faculty and I believe we ought to laser illuminated it. "Like competent speakers who do not understand the grammatical underpinnings of language, people tend to have strong, gut-level opinions about what is moral but are unable to give coherent explanations. Marc D. Hauser, a Harvard University psychologist, wants to do for morality what MIT linguist Noam Chomsky did for language—he wants to discover the universal "moral grammar." Chomsky suggested that humans are born with a "universal grammar," a cognitive capacity that helps us acquire language and shapes the way we apply language rules. Hauser thinks our moral grammar works the same way, helping us isolate moral lessons from our culture and make judgments about right and wrong. In Moral Minds, Hauser reviews what we already know about innate human faculties—for instance, that even infants seem to understand that people and animals have intentions, whereas inanimate objects do not. And he presents evidence that our universal morality is probably based on rules about fairness, proportionality and reciprocity, among other things. The material is captivating and ranges from philosophy to anthropology to psychology, including some of Hauser's own original work. Hauser's main failing is that he sometimes loses the thread of his argument; he piles on the detail but fails to make it clear how his examples support his argument. The upshot, though, is that we do not yet know exactly how our moral grammar works or even which cognitive capacities contribute to our moral faculty. Hauser's achievement is to argue convincingly that such a faculty exists and to raise some of the many questions that have to be answered before we will fully understand it." [127]Traditionally the moral faculty has universally been linked to the virtuous behavior that results from the practice of the Golden rule (do unto others as you would have them do unto you). But the reverse (I do unto others as they do unto me and I do unto others as they do unto others) is now emerging as scientifically true as well. One of the most important discoveries in neuroscience is the Mirror Neuron System of the brain (figure 19). It is precisely in this system that we are finding the biological roots of empathy which is the universal foundation of morality. I believe that with coherent information and the visual powers of lasers we can fully activate and educate this essential faculty. This visual moral application of information will guard you against the abuse of vicarious traumatization (compassion fatigue) or the overruling of reason by TV programming with "fear mongering: repetition, making the irregular seem regular, and misdirection."[128]

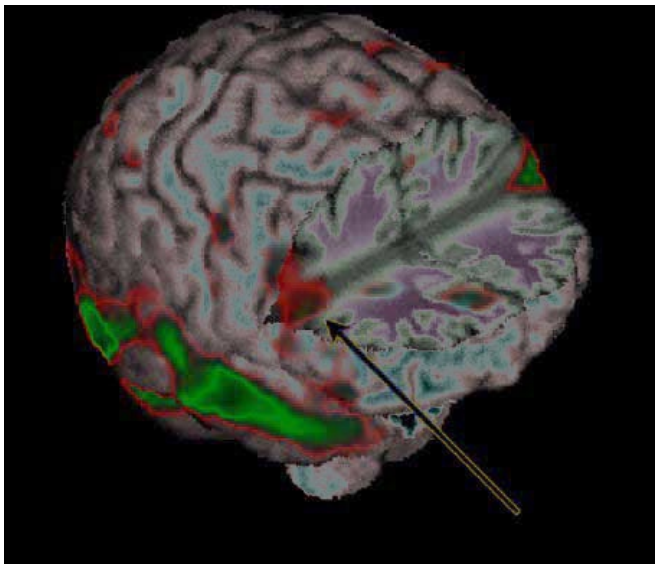

Figure 19. Locations of mirror neurons. A mirror neuron is a neuron which fires both when an animal acts and when the animal observes the same action performed by another (especially conspecific) animal. Thus, the neuron "mirrors" the behavior of another animal, as though the observer were itself acting. These neurons have been directly observed in primates, and are believed to exist in humans and in some birds. In humans, brain activity consistent with mirror neurons has been found in the premotor cortex and the inferior parietal cortex. Credit: courtesy of Wikipedia. [129]

In a similar Chomskean approach to his book—Mind @ Light Speed, A New Kind of Intelligence—Dr. Nolte portrays a universal grammar of visual symbols that will serve as a foundation for the concept of laser intelligence that we will be using in this book. In this direction as I was investigating the foundation of information theory (figure 20), I discovered that we are entering a laser information age in which both the medium and message are characterized by the laser.[130] Clear evidence that we are creating a laser informed world is in the emergence of the fiber and free space optical systems of communication. "Fiber-optic communication (figure 21) is a method of transmitting information from one place to another by sending light through an optical fiber. The light forms an electromagnetic carrier wave that is modulated to carry information (figure 20). First developed in the 1970s, fiber-optic communication systems have revolutionized the telecommunications industry and played a major role in the advent of the Information Age. Because of its advantages over electrical transmission, the use of optical fiber has largely replaced copper wire communications in core networks in the developed world. [According to Wikipedia]; Free Space Optics (FSO) is a telecommunication technology that uses light propagating in free space to transmit data between two points. The technology is useful where the physical connection of the transmit and receive locations is difficult, for example in cities where the laying of fiber optic cables is expensive. Free Space Optics is also used to communicate between space-craft, since outside of the atmosphere there is little to distort the signal. The optical links usually use infrared laser light, although low-data-rate communication over short distances is possible using LEDs. Infrared Data Association (IrDA) like your TV remote control is a very simple form of free-space optical communications. Distances up to the order of 10 km are possible, but the distance and data rate of connection is highly dependent on atmospheric conditions."[131]

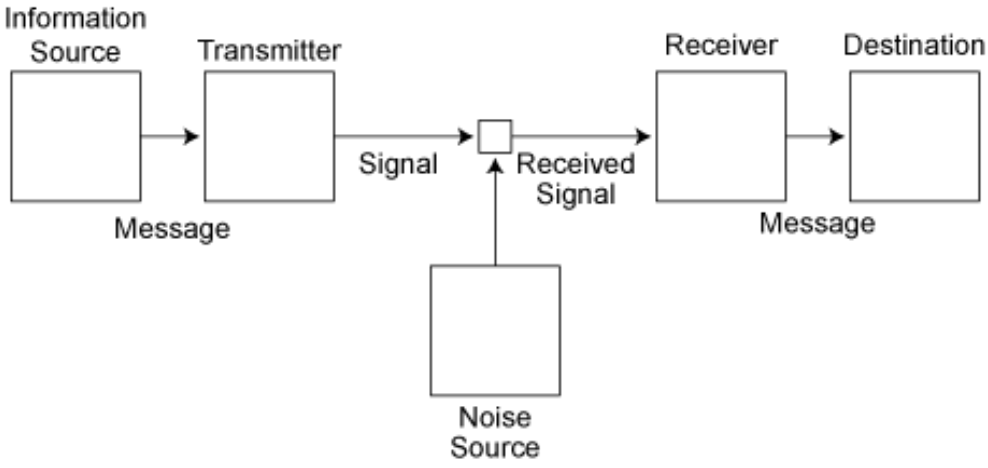

Figure 20. Here is an illustration of a Mathematical Theory of Communication" which is an influential 1948 article by mathematician Claude E. Shannon. As an MIT electrical engineer working at Bell Labs he became "the father of information theory. This article was one of the founding works of the field. This theory is now encoded in all Optical communications which is any form of telecommunication that uses light as the transmission medium. An optical communication system consists of a transmitter, which encodes a message into an optical signal, a channel, which carries the signal to its destination, and a receiver, which reproduces the message from the received optical signal. Credit: courtesy of Wikipedia [132]

The growing integration of lasers into computer software and hardware made me realize that we are seriously creating the optical computer. Clear evidence for this idea is in the laser mouse, the laser keyboard, the optical disk drive (CD, DVD player and Blue-ray), the holographic drive,[133] laser displays (Projectors, TV and computer monitors), Intel's hybrid silicon laser microchip (fig.22) and IBM's silicon nanophotonic laser modulator (fig.23) for a supercomputer-on-a-chip.[134]According to Wikipedia; "An optical computer is a computer that uses light instead of electricity (i.e. photons rather than electrons) to manipulate, store and transmit data. Photons have fundamentally different physical properties than electrons, and researchers have attempted to make use of these properties to produce computers with performance and/or capabilities greater than those of electronic computers. Optical computer technology is still in the early stages: functional optical computers have been built in the laboratory, but none have progressed past the prototype stage. Most research projects focus on replacing current computer components with optical equivalents, resulting in an optical digital computer system processing binary data. This approach appears to offer the best short-term prospects for commercial optical computing, since optical components could be integrated into traditional computers to produce an optical/electronic hybrid. Other research projects take a non-traditional approach, attempting to develop entirely new methods of computing that are not physically possible with electronics."[135]

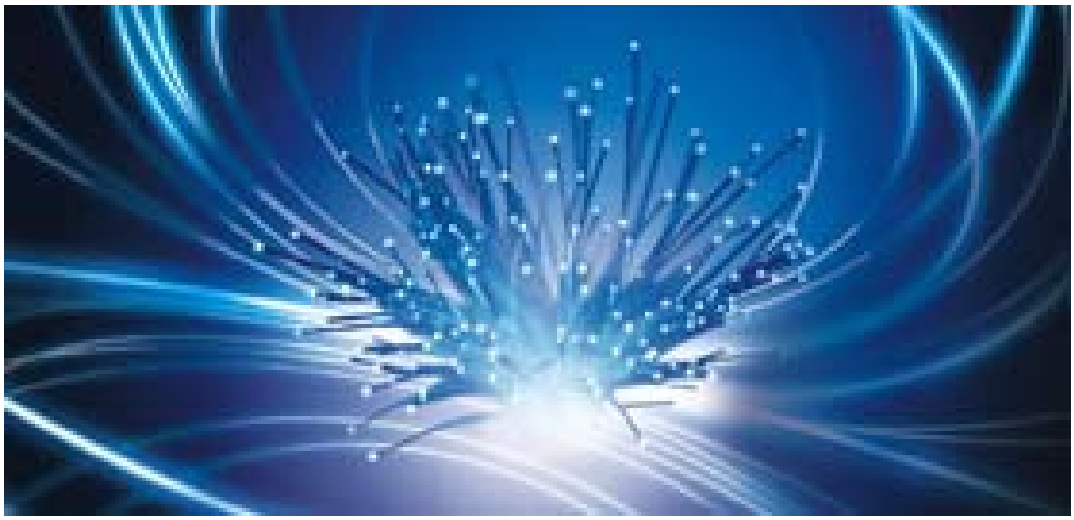

Figure 21.The Fiber Optics infrastructure of a new Laser Informed World illuminates humanity with a quadruple play of services: power, video, audio and data over the internet protocol (PoIP). Credit: courtesy of Corning. [136]

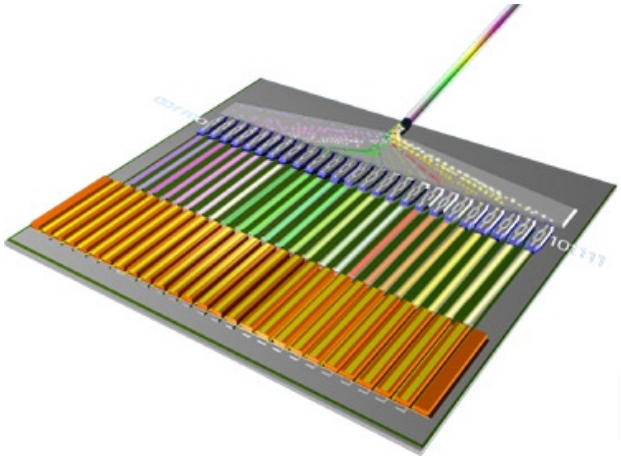

Figure 22.Intel's concept image of a future integrated terabit silicon optical transmitter containing 25 hybrid silicon lasers, each emitting at a different wavelength, coupled into 25 silicon modulators, all multiplexed together into one output fiber. With this highly integrated silicon photonic transceiver, it is possible to imagine a future world in which most computing devices are endowed with high–bandwidth optical connectivity. Be they servers, desktops, or smaller client devices, all devices will have access to substantially greater bandwidth at a lower cost. Credit: Courtesy of Intel Corporation. [137]

This laser realization led me to the recognition of the 3 faces of information (content, structure and physics).[138] Perhaps the greatest scientific idea of the laser information age is the growing understanding and practice of those three faces of information. In an ascending order of abstraction the first face is content as video, audio and print over multi-media (T.V. programs, Radio, books, newspapers, magazines and the World Wide Web,). This is the face of information that the general public interacts with. The second face is the structure or container of information encoded with information theory[139] in the laser CD, DVD, Blue Ray, fiber or free space optics, wireless and wired networks or the internet infrastructure, it is content neutral. This face is mostly encountered by computer and communication engineers. The third face is information as physically real. In biology the DNA sequence or genetic sequence is a succession of letters representing the primary structure of a real or hypothetical DNA molecule or strand, with the capacity to carry information. (Figure 24)[140]

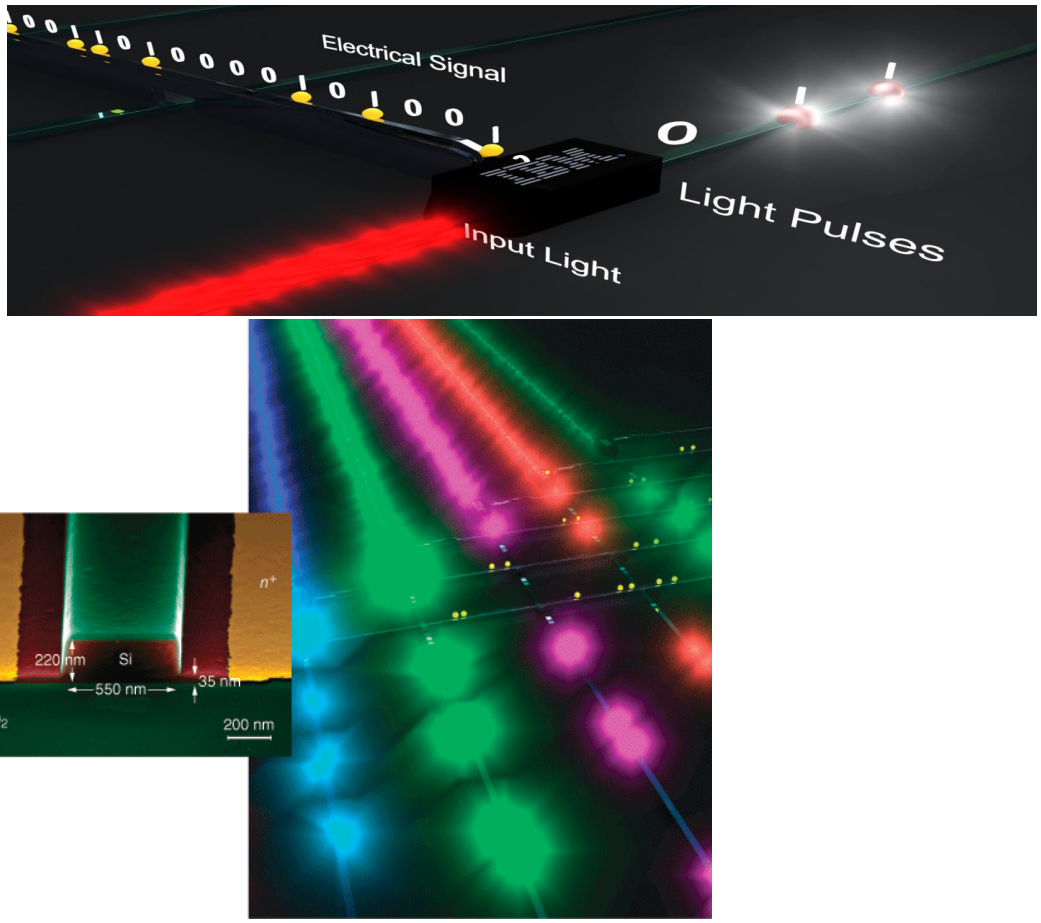

Figure 23.IBM's new silicon Mach-Zehnder optical modulator converts a digital electrical signal carried on a wire into a series of light pulses carried on a silicon nanophotonic waveguide. The waveguides are made of tiny silicon strips (purple) in a silicon-on-insulator wafer (inset). Credit: Courtesy of IBM.

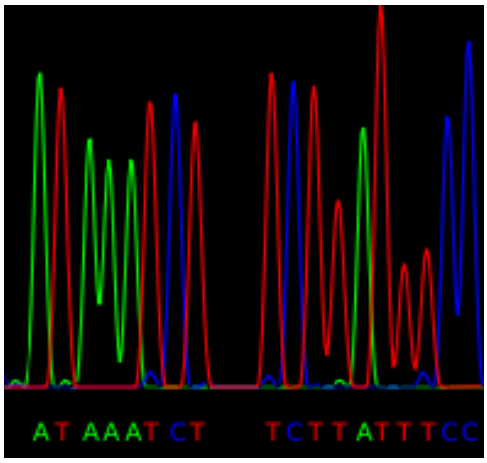

Figure 24. Electropherogram printout from automated sequencer showing part of a DNA sequence. Each of the three dideoxynucleotides fluoresces a different color when illuminated by a laser beam. An automatic scanner records each wavelength of light and a computer generates an Electropherogram with colored peaks representing each wavelength in the sequence it passes through the beam. Credit: courtesy of contexo. info. [141]

According to Dr. Nolte Holographic computers and the networked architecture of lasers are now emerging as the main carriers of information.[142] This face is seen by some of the most advanced scientist, researchers, philosophers and holographic artist. (Figure 25) Dr. Nolte goes further by stating that "we can move beyond the serial intelligence of fiber to machines in which images become the units of information. In these visual machines, images control images. Such machines are not necessarily digital in nature, nor do they need to be classified as "universal" computers in the sense of a Turing machine. Instead, they have specialized talent: in particular, the talent of processing and analyzing visual information… Dr Nolte quoted the father of holography when he said that "it is quite possible to translate, by means of a hologram, a Chinese ideogram into its corresponding English sentence, and vice versa. Dennis Gabor, 1971"[143] The holographic paradigm is also emerging in the theoretical physical community. In Einstein's classical sense "the physical universe is widely seen to be composed of "matter" and "energy". But in his 2003 article (Information in the Holographic Universe — Theoretical results about black holes suggest that the universe could be like a gigantic hologram) published in Scientific American magazine, Jacob Bekenstein summarized a current trend started by John Archibald Wheeler, a student of Albert Einstein, which suggests scientists may "regard the physical world as made of information, with energy and matter as incidentals." This quantum development of information theory has led to the fusion or equivalence connection between Energy, matter and information.[144] "The holographic principle states that the entropy of ordinary mass (not just black holes figure 26)) is also proportional to surface area and not volume; that volume itself is illusory and the universe is really a hologram which is isomorphic to the information "inscribed" on the spherical surface of its boundary."[145]

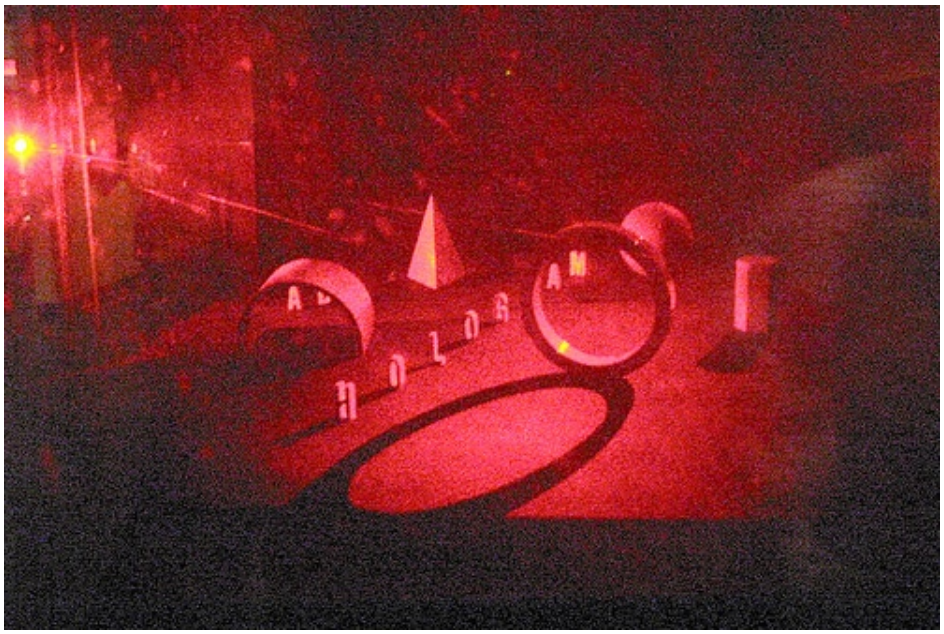

Figure 25. Hologram Artwork from the MIT Museum, founded in 1971, is the museum of the Massachusetts Institute of Technology, located in Cambridge, Massachusetts. It hosts collections of holography, artificial intelligence, robotics and history of MIT. Its holography collection of 1800 pieces is the largest in the world. Holography (from the Greek, ὅλος-hòlòs whole + γραφή-grafè write) is the science of producing holograms; it is a form of photography that allows an image to be recorded in three dimensions. The technique of holography can also be used to optically store, retrieve, and process information. Credit: courtesy of Wikipedia.[146]

A more personal account of how the reductionist scientific community accepted the notion of the Holographic principles is given in the book: The Black Hole War: My Battle with Stephen Hawking to Make the World Safe for Quantum Mechanics by Leonard Susskind. An Amazon reviewer gives us an excellent summary of this reductionist worldview. "Susskind describes the decades-long battle between the quantum mechanics community and the general relativists as to whether information is lost when objects pass through the event horizon of a black hole and the hole eventually evaporates. According to Prof. Hawking and the GR community, as nothing can ever reappear from inside an event horizon, the information is indeed totally lost. Susskind and Gerard 't Hooft begged to differ. Loss of information would violate the basic time-reversibility of QM: Hawkins's ideas would lead to universe-destroying phenomena (p. 23). Somehow, the information locked in the wrong side of the event horizon must leak out via Hawking radiation. But how? The resolution of this dilemma took many years of conjectures and refutations. Susskind takes us on a tour of entropy, holographic principles and physics at the Planck scale. And the adversarial plot keeps the reader turning the pages. I am normally very dubious about popularizations. They proceed by raking up endless analogies which never quite fit together, so that by the end of the book, your mind is like that jig-saw puzzle you bought and could never fit together. This book was never going to be the exception - the mathematics of quantum field theory; general relativity and string theory are just too arcane for popular culture concepts to cohere around. However, there are wonderful insights all the way through this book and we do end up learning something about the large scale map of the territory. Apparently even the experts find it hard to get the whole thing into one focus."[147] One of the reasons why these experts cannot get a holistic focus of nature is because of the reductionist lens that this particular group applies to science. "Reductionism can either mean (a) an approach to understanding the nature of complex things by reducing them to the interactions of their parts, or to simpler or more fundamental things or (b) a philosophical position that a complex system is nothing but the sum of its parts, and that an account of it can be reduced to accounts of individual constituents.[1] This can be said of objects, phenomena, explanations, theories, and meanings."[148]

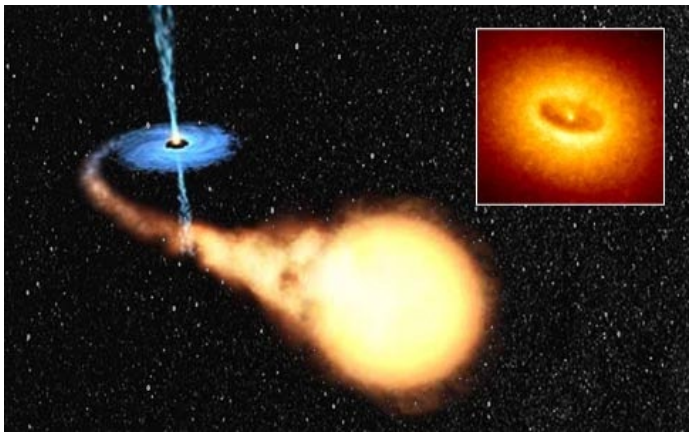

Figure 26. An artist's concept of a black hole in a binary system shows a star (at right) feeding an accretion disk surrounding the black hole. The insert shows an image recorded by the Hubble Space Telescope of a massive black hole at the center of the galaxy NGC4261. Credit: courtesy of Laurence Livermore Laboratory.

In contrast to the particle or reductionist view above, the ultimate goal of our Laser Information Age book is to see the wave structure of matter via a collective, practical and emergent pathway to the coherent unification of quantum-relativity science. I agree with "Professor Jeffrey Goldstein in the School of Business at Adelphi University. He provides a current definition of emergence in the journal, Emergence. *(*Goldstein 1999*)*. For Goldstein, emergence can be defined as: "the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems."*(*Corning 2002*)*. Goldstein's definition can be further elaborated to describe the qualities of this definition in more detail: "The common characteristics are: (1) radical novelty (features not previously observed in systems); (2) coherence or correlation (meaning integrated wholes that maintain themselves over some period of time); (3) A global or macro "level" (i.e. there is some property of "wholeness"); (4) it is the product of a dynamical process (it evolves); and (5) it is "ostensive" - it can be perceived. For good measure, Goldstein throws in supervenience -- downward causation." *(*Corning 2002*)*. "[149]

In part 2, We will be showing how, starting in 2010, the National Ignition Facility—NIF's 192 (figure 27) of the most powerful experimental lasers in the world located at the Laurence Livermore Laboratory in California—will be dedicated to the exploration and verification of the Holographic principle among other reductionist theories on one side and to the collectivist macro scale application of laser fusion power on the other. A new era in high energy density (HED) research will now be accessible to scientist, engineers and students. We will now be able to visualize and realize experiments within the nucleus of atoms and extend that power via photonic powerlines (fiber lasers). "HED experiments at NIF promise to revolutionize our understanding of astrophysics and space physics, hydrodynamics, nuclear astrophysics, material properties, plasma physics, nonlinear optical physics, radiation sources and radiative properties and other areas of science." [150]

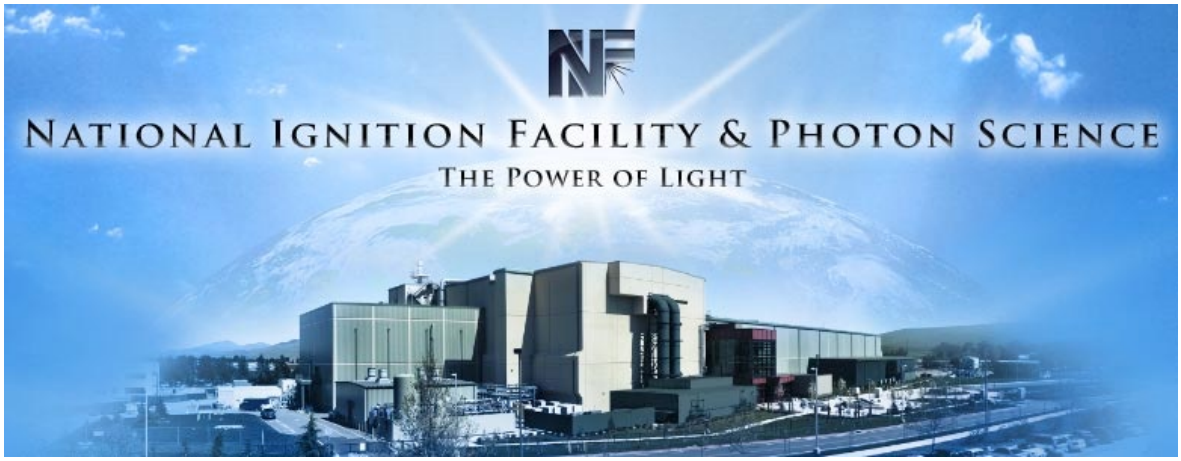

Figure 27.To create a miniature star on Earth**:** that's the goal of the National Ignition Facility (NIF), the world's largest laser. NIF will focus the intense energy of 192 giant laser beams on a BB-sized target filled with hydrogen fuel – fusing, or igniting, the hydrogen atoms' nuclei. This is the same fusion energy process that makes the stars shine and provides the life-giving energy of the sun. In February the NIF Project was completed; 192 Beams Fired to Target Chamber. Just before 2:00 AM on Feb. 26, the first 192-beam system shot to the center of the National Ignition Facility Target Chamber was fired, marking the unofficial completion of the NIF construction project. An average of 420 joules of ultraviolet laser energy, known as 3ω, was achieved for each beamline, for a total energy of more than 80 kilojoules (a joule is the energy needed to lift a small apple one meter against the Earth's gravity). The shot cycle preparing for the shot ran smoothly. All data were acquired and were nominal."This a major milestone for the greater NIF team around the nation and around the world," said NIF & Photon Science Principal Associate Director Ed Moses. "Although not required for formal completion of the NIF Project," added Project Director Ralph Patterson, "it is extremely satisfying to wind up the project by firing all beams." Credit: courtesy of Laurence Livermore Laboratory @ https://lasers.llnl.gov/. See PBS Report March 17, 2009 Researchers Aim for Clean Energy with Fusion Facility.[151]

In the Foreword to a wonderful book titled: Fusion, The Energy of the Universe by Garry McCracken and Peter Stott,[152] there is a very clear and precise summary of why laser fusion is one of the genuine sources of power for our future civilization."Fusion powers the stars and could in principle provide almost unlimited, environmentally benign, power on Earth. Harnessing fusion has proved to be a much greater scientific and technical challenge than originally hoped. In the early 1970s the Great Russian physicist Lev Andreevich Artsimovich wrote that, nevertheless, "thermonuclear [fusion] energy will be ready when mankind needs it," It looks as if he was right and that the time is approaching. This excellent book is therefore very timely. The theoretical attractions of fusion energy are clear. The raw fuels of a fusion power plant would be water and lithium. The lithium in one laptop computer battery, together with half a bath of water, would generate 200.000 kWh of electricity—as much as 40 tons of coal. Furthermore, a fusion power plant would not produce any atmospheric pollution (greenhouse gases, sulfur dioxide, etc.), thus meeting a requirement that is increasingly demanded by society." Dr. Laughlin who actually worked at Laurence Livermore Laboratory stated that "laser fusion itself—the creation of a hot fusion environment by focusing gigantic lasers onto a tiny pellet of fuel—did not work as originally proposed because of overoptimistic assumptions about the implosion convergence, but the research did create the initial investments that now led to new, conservative designs that will work—I think. Whether all the financial shenanigans will be forgiven when a laser fusion pellet finally goes off remains to be seen, but the world will certainly be stunned and, I suspect, fundamentally changed."[153]

Stars are mostly made of plasma (4th state of matter, ionic or electrically charged gas), but in some, like Eta Carinae (figure 28 and 29) there is a 5th state of matter known as coherent. The NIF Science Mission is actively seeking to re-create this state in the lab. "The coupling of high-intensity laser light to plasmas has been the subject of experimental investigations for many years. These experiments have focused on measuring a broad range of phenomena such as resonance and collisional absorption, filamentation, density profile and particle distribution modification, and the growth and saturation of various parametric instabilities. These phenomena depend on both the properties of the laser (intensity, wavelength, pulse length coherence, etc.) and the composition of the plasma."[154] A natural example of this coupling between lasers and plasma in Mother Nature is illustrated in the powerful Eta Carinae: 'Have you heard about the great LASER light show in the sky? Well, nobody had until it was announced just yesterday (January 10, 1995 12:00 AM EST)) by a team led by K. Davidson (U. Minnesota) and S. Johansson (U. Lund). The research team discovered that the unusually variable star Eta Carinae emits ultraviolet light of such a specific color it is most probably LASER light! The artist's conception shown in figure 29 depicts a possible model for the Hubble Space Telescope observations. In this model, Eta Carinae emits many LASER beams from its surrounding cloud of energized gas. Infrared LASERS and microwave MASERS are extremely rare astrophysical phenomena, but this ultraviolet LASER is the first of its kind to be discovered.[155]

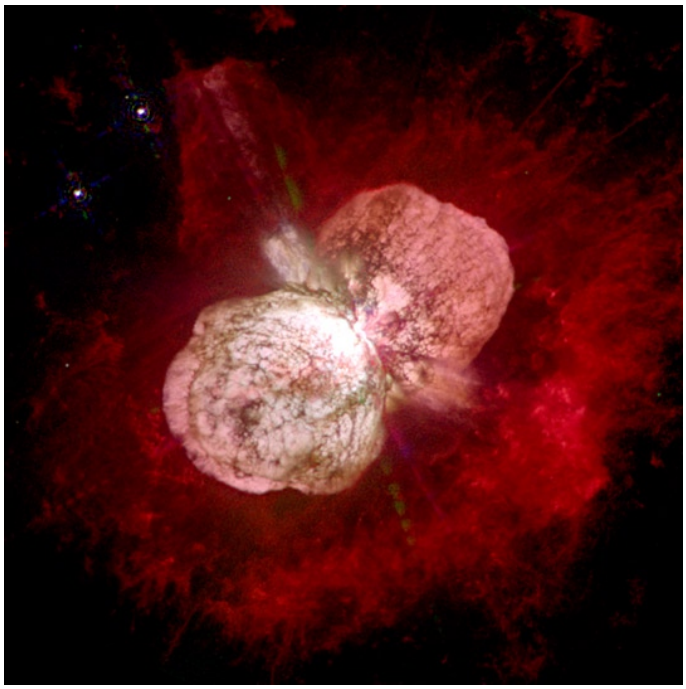

Figure 28.Object Description: Eta Carinae is the most luminous star known in our galaxy. It radiates energy at a rate that is 5 million times that of the sun. Observations indicate that Eta Carinae is an unstable star that is rapidly boiling matter off its surface. Some astronomers think that it could explode as a supernova any time! At a distance of 7,000 light years from Earth, this gigantic explosion would pose no threat to life but it would be quite a show. Scale: Image is 100 arcsec on a side.

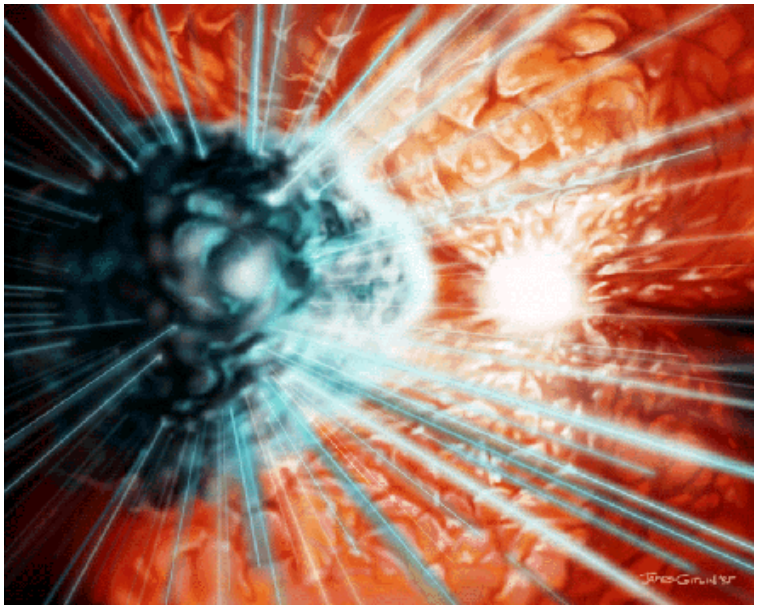

Figure 29. Lasers in Eta Carinae Astronomy Picture of the Day. Credit: NASA, J. Gitlin (StScI) Credit: courtesy of NASA.

It was precisely through my encounter with the third face of information that the notion of the Laser Informed World emerged in me. In this foundation document for the collective realization of LaserFusion and Geothermal Laser Drilled Power, I connect Einstein's quantum theory of the laser to his grand formulation of Energy, mass and light via his E=mc2 on the Geomagnetic sphere. The practical unification of Einstein's conceptual spaces (Relativity and Quantum theory) will be illustrated concretely through the Open Resource Based Economy (ORBE). Geothermal power emerged from this inquiry as the best solution for major long term problems like global warming and the establishment of a clean and unlimited energy resource for the photonic planetary grid (the internet).[156] Photonic powerlines (laser power over fiber and free space optics) are now a reality but we still need to research, develop, install, configure and integrate them into every brain, school, home, car and device on the planet. This is how we will create a clean Laser Informed World. Overall we will be seeing that Theodore Maiman's Ruby Laser (1960), and the NASA discovery of the Lambdasphere (Electron Cyclotron Maser/Laser in the geomagnetic auroras 1996 figure 30) and the emerging all optical internet are all quantum legacy of Einstein's coherent vision of the cosmos which came to him when he was 37 years old in July of 1916 (laser conception).

Prof. Goldman[157] clarified for me the relation between ideas and discoveries. He also directed my search into Einstein's radiant ideas as the source of power for social change and its subsequent discoveries as laser light. "One might think, one is tempted to speak, of scientific discoveries as being the source of science's power to be a driver of social change; that scientists have been discovering, continually and relentlessly discovering, new truths about nature, and that the change follows from that. But I want to argue and to emphasize, as I will repeatedly throughout this course, that it is scientific ideas that are responsible for this change, not discoveries; that as a matter of fact discoveries are ideas incarnate. That it is the ideas that are the source of science's power, not discoveries. Copernicus did not discover that the earth moved around the sun. It was an idea of Copernicus's that the earth moved around the sun rather than that the sun moved around the earth. Einstein did not discover the special or general theories of relativity; Einstein had an idea that led to the special theory of relativity. A different but related idea, as we will discuss in a later lecture, led to the general theory of relativity. It was when these ideas panned out, so to speak, when these ideas were accepted because of their explanatory power, or confirmed by subsequent experimentation, that scientists said that they had discovered new truths about nature; that they had discovered new facts about the universe."[158] Dr. Laughlin is even more specific in this relation between invention and discovery in Einstein when he stated "that relativity (1905) was a discovery and not an invention. It was subtly implicit in certain early experimental observations about electricity, and it took bold thinking to synthesis these observations into a coherent whole… Einstein theory of gravity (the general theory of relativity of 1915), in contrast, was an invention, something not on the verge of being discovered accidentally in the laboratory. It is still controversial and largely beyond the reach of experiment…the Laser Interferometer Gravitational –Wave observatory project (LIGO), hopes eventually to directly detect gravitational waves generated by astrophysical phenomena." [159]

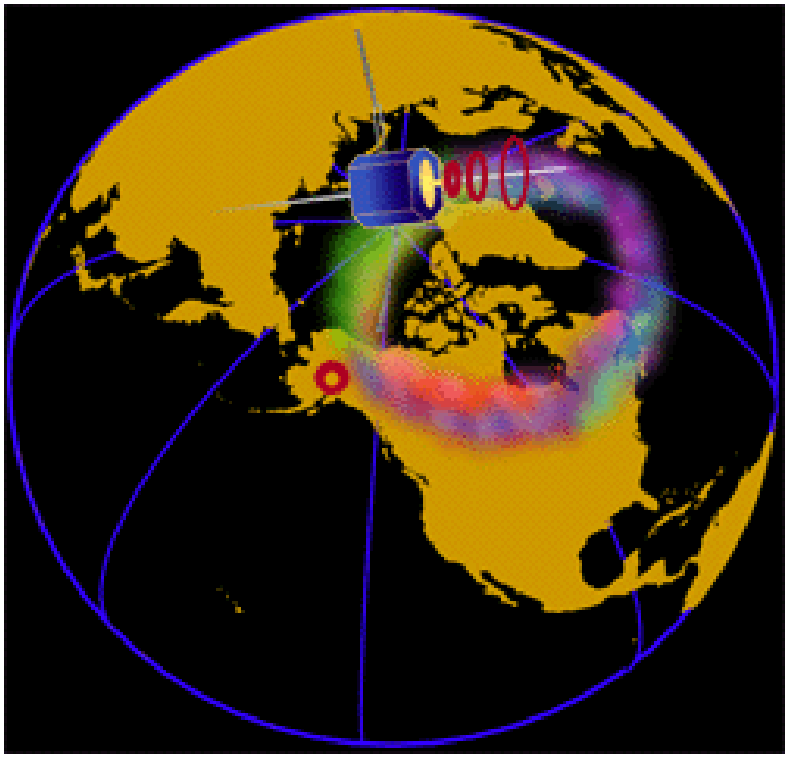

Figure 30. NASA's Fast Auroral Snapshot Explorer (FAST), which was launched on August 21, 1996 aboard a Pegasus XL vehicle. FAST is probing the physical processes that produce aurorae, the displays of light that appear in the upper atmosphere at high latitudes (northern lights).[160] Credit: courtesy of NASA.

Einstein thrived on the visual continuum of ideas or their imagined connectedness in space-time.[161] In **Einstein: His Life and Universe by Walter Isaacson**—one of the best books about Einstein I have ever read—there is a wonderful description of his visual talent. "I wanted to capture the imaginative beauty of Einstein's scientific leaps… As a patent examiner, he got to visualize the physical realities underlying scientific concepts. The least true legend is that he failed math as a schoolboy. He was actually great in math, because he could visualize equations. He knew they were nature's brushstrokes for painting her wonders. For example, he could look at Maxwell's equations and marvel at what it would be like to ride alongside a light wave, and he could look at Max Planck's equations about radiation and realize that Planck's constant meant that light was a particle as well as a wave. The most true legend is how rebellious and defiant of authority he was. You see it in his politics, his personal life, and his science."[162] Through this creative visual act, Einstein was able to fuse a 500 year history of the concepts of energy, mass, and the speed of light synthesized in his famous formula $\mathbf{E=mc^2}$.[163]

Figure 31. Albert Einstein: German-born theoretical physicist and social democrat, 1905 Annus Mirabilis Papers. My political ideal is democracy. Let every man be respected as an individual and no man idolized…My passionate sense of social justice and social responsibility has always contrasted oddly with my pronounced lack of need for direct contact with other human beings and human communities… This topic brings me to that worst outcrop of herd life, the military system, which I abhor... This plague-spot of civilization ought to be abolished with all possible speed. Heroism on command, senseless violence, and all the loathsome nonsense that goes by the name of patriotism -- how passionately I hate them!.. I am satisfied with the mystery of life's eternity and with a knowledge, a sense, of the marvelous structure of existence -- as well as the humble attempt to understand even a tiny portion of the Reason that manifests itself in nature." The World As I See It, An Essay by Einstein. Credit: courtesy of Wikipedia[164]

The five components of the equation (E, =, m, c and "2 or squared"), means that it covers 16th thru 21st century physics. Einstein's "'E for Energy" is based on Michael Faraday's[165] idea of the unity between electricity, magnetism, gravitation and the other forces of nature that were discovered later, i.e. the strong force (nuclear) and weak force (radioactive). Faraday was a 19th century experimental scientist whose visual thinking powers helped him invent the idea that electricity and magnetism were the same force. He envisioned the unification of electromagnetism and gravitation but not its mathematization. The actual unification and mathematization of electro-magnetism was accomplished by James Clerk Maxwell. The concept of "'m for Mass" brings in the French chemist Antoine-Laurent Lavoisier who established the law of conservation of matter. 'The law of conservation of mass/matter, also known as law of mass/matter conservation (or the Lomonosov-Lavoisier law), states that the mass of a closed system will remain constant, regardless of the processes acting inside the system. An equivalent statement is that matter cannot be created/destroyed, although it may be rearranged. This implies that for any chemical process in a closed system, the mass of the reactants must equal the mass of the products. The law of "matter" conservation (in the sense of conservation of particles) may be considered as an approximate physical law that holds only in the classical sense before the advent of special relativity and quantum mechanics. Mass is also not generally conserved in open systems, when various forms of energy are allowed into, or out of, the system. However, the law of mass conservation for closed systems, as viewed from their center of momentum inertial frames, continues to hold in modern physics."[166]

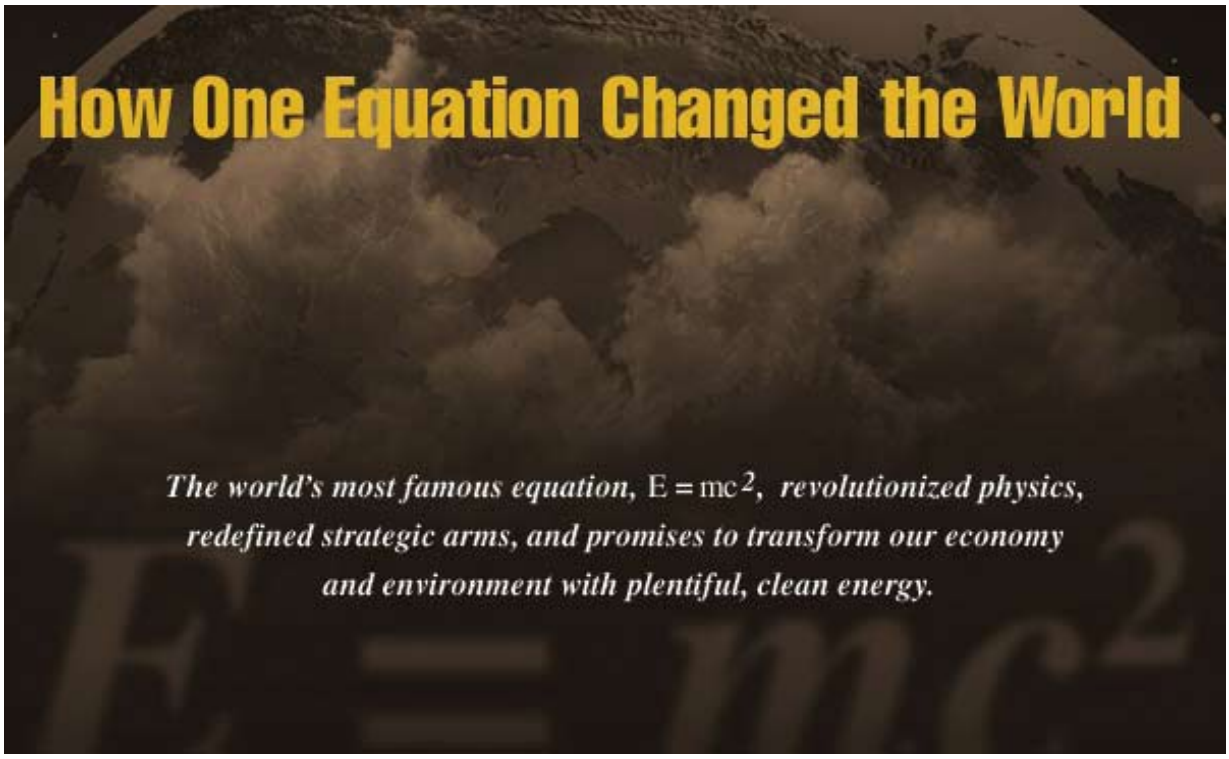

Figure 32. Many scientists, like Bruce Goodwin (Laurence Livermore Laboratory's associate director for Defense and Nuclear Technologies) argue that the world needs to move to a fusion economy. "Nuclear weapon designers have understood fusion for 50 years. The challenge is to harness that understanding for producing civilian energy." He notes that the National Ignition facility (NIF) will be the first laboratory to have controlled nuclear fusion, a critical step toward clean and abundant energy. In that light, $E=mc^2$, Goodwin says, offers to transform life on Earth because of the prospect of abundant clean energy. Credit: courtesy of Laurence Livermore Laboratory.

The squared "2" was invented by a smart and beautiful French woman named Emilie du Châtelet (1705-1749).[167] She was inspired by Gottfried Leibniz,[168] corrected Voltaire[169] and improved Newton[170]'s formula who stated that an object's energy is simply the product of its mass times its velocity, or mv1.[171] The symbol = was introduced in the middle of the 16th century by Robert Recorde,[172] (a mathematics textbook writer in Great Britain) who wanted to make his math books clear and accessible. "C" for the speed of light was first measured accurately by a Danish astronomer named Ole Roemer in 1671.[173] The speed of light in the vacuum of free space is an important physical constant usually denoted by the letter c.[1] It is the speed of all electromagnetic radiation, including visible light, in free space. It is the speed of anything having zero rest mass [2]. In metric units, the speed of light in vacuum is defined to be exactly 299,792,458 meters per second (1,079,252,849 km/h).[3] The speed of light can be assigned a definite numerical value because the fundamental SI unit of length, the meter, has been defined since October 21, 1983, as the distance light travels in a vacuum in 1/299,792,458 of a second; in other words, any increase in the measurement precision of the speed of light would refine the definition of the meter, but not alter the numerical value of c. The approximate value of 3×108 m/s is commonly used in rough estimates (the error is 0.07%). In imperial units, the speed of light is about 670,616,630.6 miles per hour or 983,571,056 feet per second, which is about 186,282.397 miles per second, or roughly one foot per nanosecond.[174]

In honor of Einstein's centennial (2005) legacy of **$E=mc^2$** the Laurence Livermore National Laboratory published a very important update on the historical continuum of this formula and its application to laser fusion energy at the National Ignition Facility (NIF figure 34 & 35). The following history was written and illustrated by the *Science & Technology Review* with expanded references and pictures from Wikipedia by the author.

Figure 33. Light traveling through a medium such as air (for example, this laser) travels slower than light through a vacuum. The speed of light when it passes through a transparent or translucent material medium, like glass or air, is less than its speed in a vacuum. The ratio of the speed of light in the vacuum to the observed phase velocity is called the refractive index of the medium. Credit: courtesy of Wikipedia

Figure 34.The National Ignition Facility, or NIF, is a high-energy, high-power laser-based inertial confinement fusion (ICF) research device under construction at the Lawrence Livermore National Laboratory, in Livermore, California. NIF is the largest and most powerful ICF built to date and the first that is designed to reach the long-sought goal of "ignition". The 192 laser beams at NIF will generate a peak power of 500 trillion watts, 1000 times the electric generating power of the United States, a pulse energy of 1.8 million joules of ultraviolet light, a pulse length of three to twenty billionths of a second. Taxpayer cost is about $4 Billion according to the Natural Resources Defense Council estimates. Credit: courtesy of Laurence Livermore Laboratory.[175]

"In many respects, Lawrence Livermore's national security and energy missions are part of – and a tribute to – Albert Einstein's legacy. A number of Livermore research projects are linked to a three-page paper written by Einstein in September 1905. This short paper, which contained no footnotes or references, turned physics upside down by linking mass and energy in a way never before postulated. Albert Einstein's legacy in three-page paper written by Einstein in September 1905. This short paper, which contained no footnotes or references, turned physics upside down by linking mass and energy in a way never before postulated. Published in the German journal Annalen der Physik, the paper was entitled, "Does the Inertia of a Body Depend on Its Energy Content?" It was a supplement to Einstein's work on special relativity that appeared in the same physics journal earlier that year. The text begins: "The results of an electrodynamics investigation recently published by me in this journal lead to a very interesting conclusion, which will be derived here." The paper applied the special theory of relativity to light being emitted from a stationary object. Einstein concluded that if a body emits an amount of energy, E, in the form of radiation, then its mass, m, must be reduced by the amount E/c^2, where c is the speed of light. This reasoning led to the equation $E=mc^2$, probably the most famous equation in the world. $E=mc^2$ does not appear explicitly in the 1905 paper; however, it does appear in Einstein's later work in 1906 and 1907. Because the speed of light is a very large number – 299,792,458 meters per second – and is multiplied by itself, a small amount of matter is equivalent to an enormous amount of energy. For example, a kilogram of mass converts to 21 million tons of TNT energy.

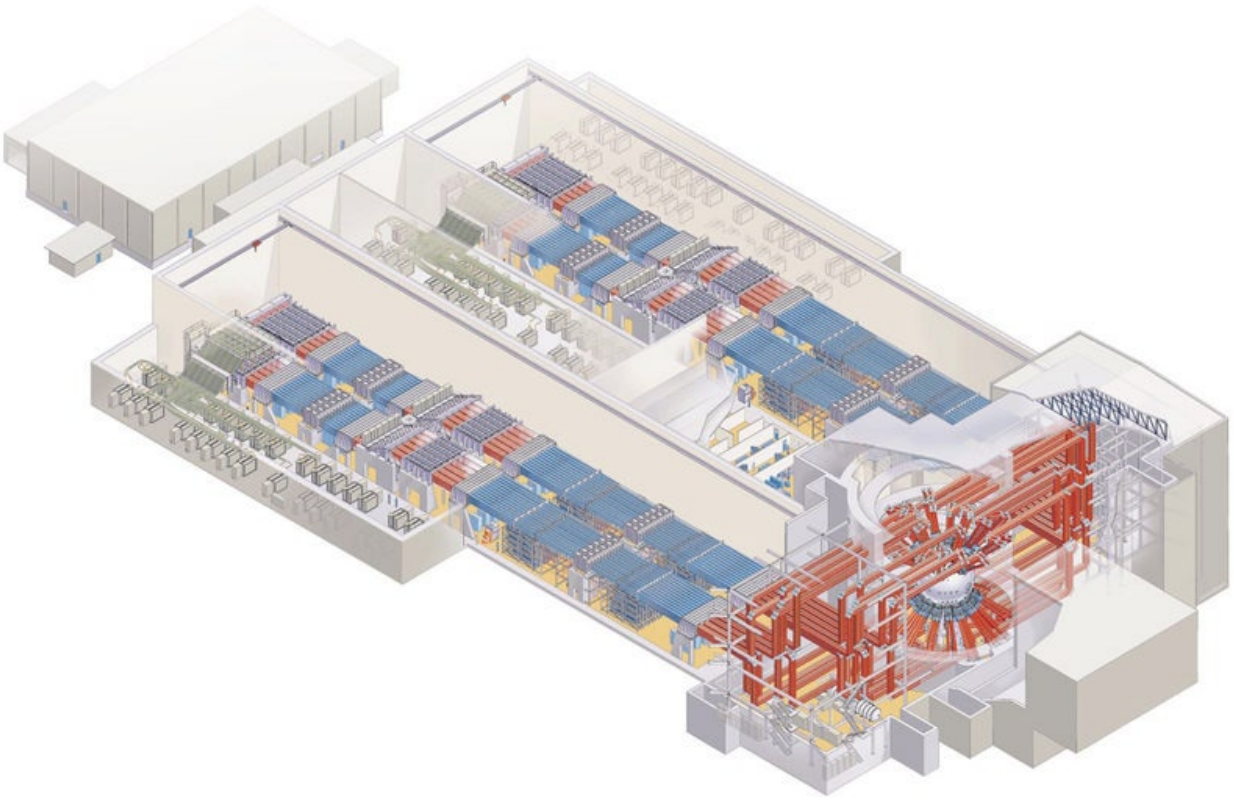

Figure 35. NIF's basic layout. The laser pulse is generated in the room just right of center, and is sent into the beamlines (blue) moving into the main amplifiers at the top-right. After several "bounces" through them the light is sent into the directors (red) where it is aimed and "cleaned" before entering the target chamber (silver). The target area is set up for the indirect drive mode, but the additional ports for direct drive experiments can also be seen. The building in the upper left is a construction plant for the optical glass.[176] Credit: courtesy of Wikipedia.

Einstein did not expect his result to be easily confirmed because it would have been too difficult to measure the small amounts of mass converted in the radiation emissions that were experimentally accessible at the time. He concluded his paper by conjecturing that radioactive materials, such as radium salts, might provide a means to test the theory. Full confirmation of the equation did not occur until the 1930s, following elucidation of the structure of the nucleus as an assemblage of neutrons and protons. In 1932, James Chadwick discovered the neutron (figure 36). That same year, John Cockcroft and E. T. S. Walton bombarded a lithium nucleus with a proton and produced a nuclear reaction. The experiment demonstrated the accuracy of Einstein's equation by showing that a small amount of mass could be converted into energy. One year later, Irène and Frédéric Joliot-Curie demonstrated the reverse process, when they took a photograph showing the conversion of energy into subatomic particles. Over time, scientists grew to realize that huge amounts of energy could be liberated in nuclear reactions, such as those that occur in the Sun and stars. (See "Tapping the Potential of the Nucleus" below). For example, the Sun (figure37) fuses hydrogen nuclei (protons) into helium nuclei (containing two protons and two neutrons each), a process called fusion that goes on for billions of years. The masses of the protons at the start of a fusion event are slightly heavier than the mass of the helium nucleus at the end of the process: the missing mass is converted to energy. For stars more massive than the Sun, the carbon–nitrogen–oxygen cycle is the primary vehicle for fusing hydrogen nuclei into helium nuclei. Today, in a nuclear reactor, a heavy element, such as uranium, is split into two lighter elements during a process called fission. Once again, the combined mass of the products is lighter than the original nucleus. The difference in mass is converted to energy, which is used for boiling water to drive turbines.

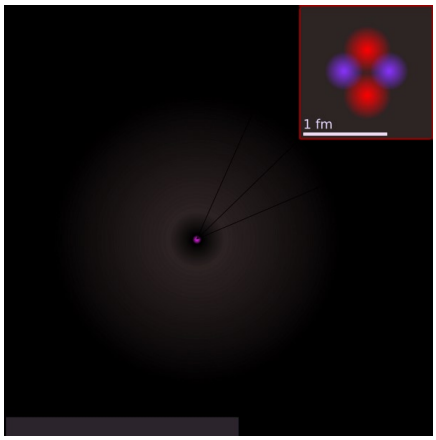

Figure 36. An illustration of the helium atom, depicting the nucleus (pink) and the electron cloud distribution (black). The nucleus (upper right) is in reality spherically symmetric, although for more complicated nuclei this is not always the case. The black bar is one ångström, equal to 10−10 m or 100,000 fm. The atom is the smallest unit of an element that retains the chemical properties of that element. An atom has an electron cloud consisting of negatively charged electrons surrounding a dense nucleus. The nucleus contains positively charged protons and electrically neutral neutrons. When the number of protons in the nucleus equals the number of electrons, the atom is electrically neutral; otherwise it is an ion and has a net positive or negative charge. An atom is classified according to its number of protons and neutrons: the number of protons determines the chemical element and the number of neutrons determines the isotope of that element. Courtesy of Wikipedia.[177]

Probing Subatomic Particles

E=mc² – together with the development of quantum mechanics and advances in nuclear physics – spawned new kinds of experiments in which physicists bombard targets with high-energy subatomic particles. Sometimes the particle collisions lead to new particles. In this respect, turning energy into matter is a well-tested method of uncovering the substructure of the universe.

Tapping the Potential of the Nucleus

The neutrons and protons are kept stable in every atom's nucleus by attractive nuclear forces. The relative stabilities of the nuclei of different elements are determined by their binding energies, that is, how much energy is required to remove a proton or neutron from the nucleus. If the binding energy of each nucleus is plotted as a function of the number of protons and neutrons it contains, a curve of binding energy is obtained. As seen in the figure 38, nuclei with a small number of neutrons and protons have a low binding energy. Such nuclei are easier to break apart and are not as stable as nuclei with larger numbers of protons and neutrons. As the number of neutrons and protons increases, the binding energy reaches a peak and then drops off again. Nuclei at the peak are the most tightly bound and correspond to elements near iron in the periodic table. As neutrons and protons continue to be added, the nucleus becomes less tightly bound. If uranium and plutonium nuclei, at the far right end of the plot, break into smaller nuclei, the pieces are harder to break apart. Thus, if a way can be found to break a uranium or plutonium nucleus, energy will be released. This process, known as fission, is typically started by trickling neutrons into such nuclei. The neutrons give these nuclei just enough energy to undergo fission. When such nuclei split, extra neutrons are given off. Under the right conditions, a self-sustaining set of reactions can occur in which more and more fissions occur. This process can either lead to a runaway reaction, as in a fission bomb, or can be kept at a steady state, as in a nuclear reactor. If very light nuclei such as hydrogen or deuterium are forced together, in a process called fusion, the resulting nucleus is in a lower energy state, and the extra energy is given off as radiation or energetic neutrons. This fusion process is more difficult to achieve than fission because the electrical repulsion of the nuclei must be overcome to get the nuclei to fuse. In the center of the Sun and other stars, nuclei have the very high temperatures and densities required for thermonuclear fusion.

The high temperatures and densities required for fusion have been achieved on Earth for only very short periods of time in thermonuclear bombs and a few research machines such as fusion tokomaks and the Laboratory's Nova laser, which operated from 1985 to 1995. Controlled fusion for energy production is being attempted in two different ways: magnetic fusion and inertial confinement fusion. In magnetic fusion, intense magnetic fields confine low-density plasma at temperatures and densities needed for fusion. In inertial confinement fusion, lasers or accelerators compress extremely small pellets to the very high densities and temperatures needed for fusion. It is interesting to compare the temperatures, densities, and confinement times of these approaches. Confinement time is the amount of time it takes for the energy in the plasma to be released. Magnetic confinement requires densities of only 10 -9 grams per cubic centimeter, temperatures of roughly 100 million kelvins, and a confinement time of several seconds. Inertial confinement requires densities of 1,000 grams per cubic centimeter, temperatures of about 100 million kelvins, and confinement times of 10 -11 seconds. The center of the Sun is calculated to reach densities of greater than 100 grams per cubic centimeter and temperatures of 16 million kelvins. Because of gravitational forces, the Sun's confinement time is as long as the age of the Sun.

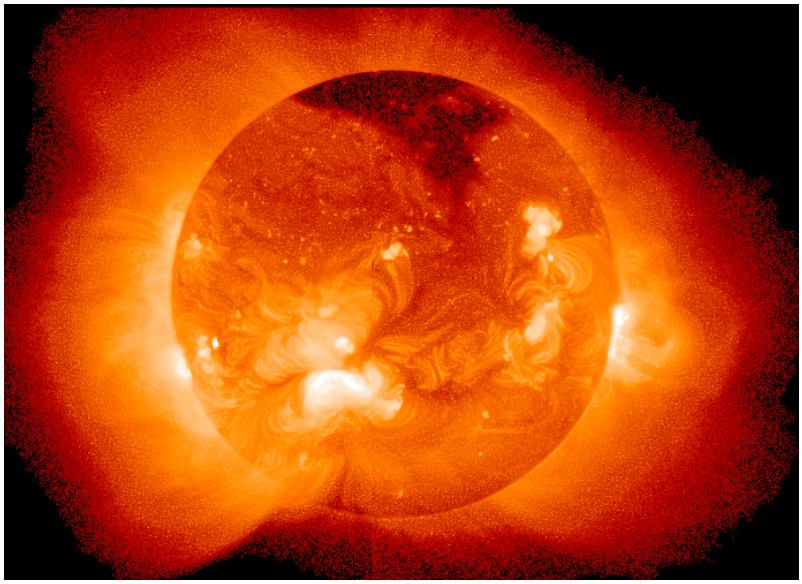

Figure 37. The Sun is a natural fusion reactor. This image shows the Sun as viewed by the Soft X-Ray Telescope (SXT) onboard the orbiting Yohkoh satellite. The bright, loop-like structures are hot (millions of degrees) plasma (electrically charged gas) confined by magnetic fields rooted in the solar interior. An image of the sun in visible light would show sunspots at the feet of many of these loops. The halo of gas extending well beyond the sun is called the corona. The darker regions at the North and South poles of the Sun are coronal holes, where the magnetic field lines are open to space and allow particles to escape.[178] Credit: courtesy of Wikipedia.

Using Lasers to Achieve Fusion

Another way to achieve controlled nuclear fusion is to implode BB-size capsules of frozen fusion fuel to the needed temperatures and densities using laser energy. This technique, called inertial confinement fusion, was pioneered at Livermore. Under the high densities involved in this concept, the fusion burn occurs in less than 100 trillionths of a second, and the inertia of the fuel itself provides the necessary confinement.. According to physicist John Lindl, former Livermore Director Johnny Foster appointed Ray Kidder to lead the Laboratory's first small laser fusion program in 1962. Beginning in 1960, John Nuckolls, Stirling Colgate, Ron Zabawski, and other physicists used weapons design codes to calculate the indirect drive approach to igniting fusion micro explosions. It seems possible that giant lasers might someday be focused to compress and ignite a small quantity of deuterium–tritium fuel for weapons applications. The challenge of inertial fusion is that laser heating alone is not enough to generate net energy, even with lasers as large as 1 megajoule. To achieve energy gain, the laser also must compress the fuel to 1,000 or more times its liquid density. "Compression is the key issue," says Lindl. "If we could compress the fuel to a high enough density while heating a small fraction of it to the temperatures required for fusion, we could achieve ignition and significant gain with a reasonable-size laser." The ignition pellets being designed for the National Ignition Facility (NIF), which is undergoing final assembly in Livermore, will be compressed to a density and temperature about 10 times those that exist in the center of the Sun.

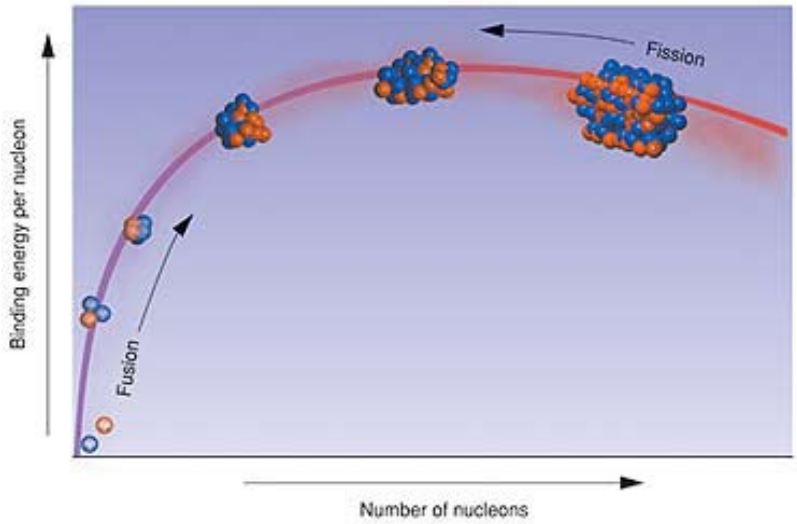

Figure 38. Nuclei with a small number of neutrons and protons have a low binding energy. As the number of neutrons and protons increases, the binding energy reaches a peak and then drops off. Uranium and plutonium nuclei are at the far right end top of the plot. If they break into smaller nuclei (fission), the pieces become more bound. For very light nuclei such as hydrogen or helium, more nuclear binding energy can be obtained if the nuclei are forced together (fusion). Credit: courtesy of Laurence Livermore Laboratory.

In 1972, Livermore's laser fusion efforts expanded with the formation of the Inertial Confinement Fusion (ICF) Program. Its goal was to demonstrate fusion in the laboratory and to develop laser science and technology for both defense and civilian applications. Experiments were carried out on a succession of increasingly sophisticated lasers – Janus,[179] Cyclops,[180] Argus,[181] Shiva,[182] and Nova.[183] "We continually bootstrapped our capabilities and knowledge," says Lindl. With Nova, researchers made good progress on laser fusion codes, diagnostics, and target design and fabrication. Livermore's laser fusion research also took advantage of underground experiments conducted at the Nevada Test Site (NTS). The data from Nova and NTS experiments guided scientists in planning NIF. As part of Livermore's NIF Programs Directorate, the current ICF Program advances design, fabrication, target experiments, and fusion target theory. The Laser Science and Technology Program advance the required laser and optical science and technology both for NIF and for future lasers that might be suitable for fusion energy applications. Much of this research supports DOE's Stockpile Stewardship Program to maintain the U.S. nuclear deterrent. Another goal is exploring ICF as a clean and inexhaustible source for commercial electric-power production. In 2004, NIF's Early Light experiments met the first milestone of Livermore's ICF Program. Ultraviolet light from NIF's first quad of lasers was aimed at gas-filled targets. The tests showed good agreement between calculations and the observed beam propagated through the target. "These experiments were very successful," says Lindl.

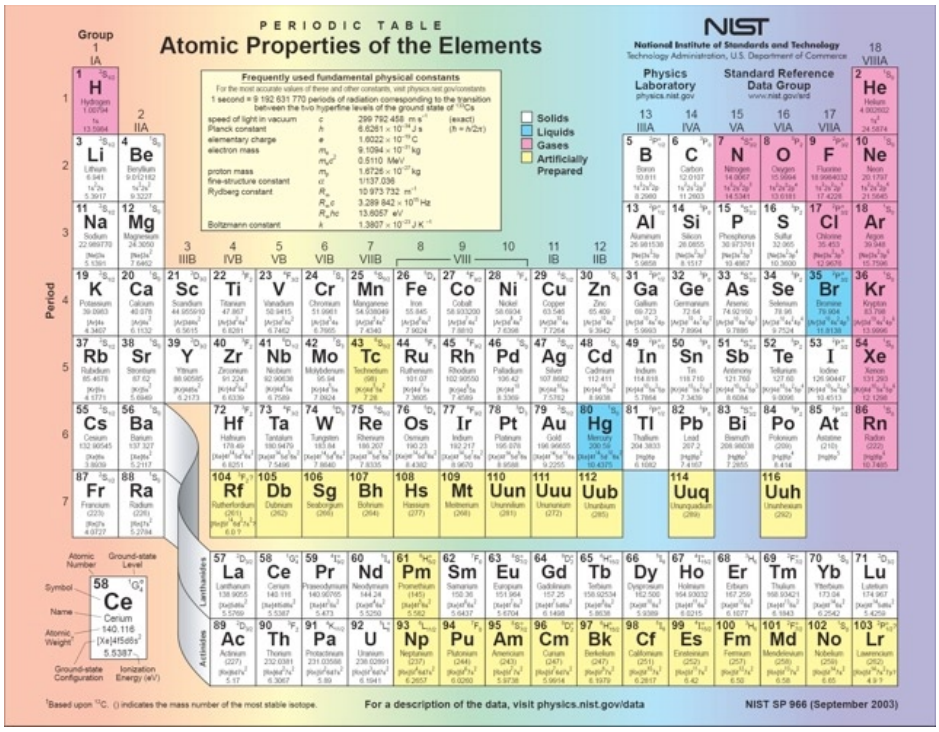

Figure 39. The periodic table of the chemical elements. A chemical element, or element, is a type of atom that is distinguished by its atomic number; that is, by the number of protons in its nucleus. The term is also used to refer to a pure chemical substance composed of atoms with the same number of protons.[1] Common examples of elements are hydrogen, carbon, nitrogen, and oxygen. In total, 117 Elements have been observed as of 2007, of which 94 occur naturally on Earth. Elements with atomic numbers greater than 82 (bismuth and above) are inherently unstable, and undergo radioactive decay. Of the first 82 elements, 80 have stable isotopes. Elements 43 and 61 (technetium and promethium) have no stable isotopes, and decay. The elements from 83 to atomic number 94 that have no stable nuclei, are nevertheless found in nature, either surviving as remnants of the primordial stellar nucleosynthesis which produced the elements in the solar system, or else as produced as newer short-lived daughter-isotopes in the natural decay of uranium and thorium.[2]All chemical matter consists of these elements. New elements of higher atomic number are discovered from time to time, as products of artificial nuclear reactions.[184] Credit: courtesy of NIST.

Nuclear Weapons a Popular Icon

Einstein was sometimes – and unfairly – called the "father of the atomic bomb." He did not foresee the release of enormous amounts of destructive energy by bombarding the nuclei of atoms. However, building on the many advances in nuclear physics that occurred after the $E=mc^2$ paper, Otto Hahn and Fritz Strassman discovered nuclear fission in uranium in 1939. Later that year, Leo Szilard conceived a way to use fission in a self-sustaining chain reactor. Aware of the progress that had been made splitting uranium atoms, Szilard and other scientists feared that Germany might be working on an atomic bomb. In late July 1939, Szilard visited Einstein to finalize the draft of a letter to warn President Franklin D. Roosevelt of the danger. Livermore Laboratory's cofounder, Edward Teller, drove Szilard to Einstein's summer cabin on Long Island and joined them in the meeting. The Einstein letter to Roosevelt dated August 2, 1939, helped set in motion the Manhattan Project, the mammoth effort to build an atomic bomb. Einstein did not participate in the Manhattan Project, and, in 1946, he became chairman of the Emergency Committee of Atomic Scientists, whose goal was to place nuclear energy under international control. The bomb that was dropped on Hiroshima had an explosive force equivalent to 15,000 tons of TNT. The Hiroshima bomb was a purely fission device, using the same nuclear process as occurs in nuclear reactors. In contrast, all current U.S. nuclear weapons rely on a mixture of fission and fusion for their explosive power.

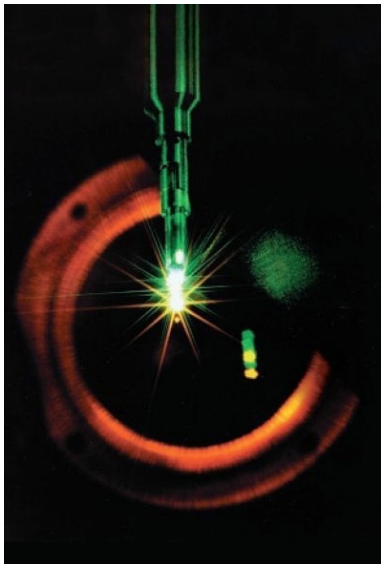

Figure 40. Inertial confinement fusion implosion on the NOVA laser creates "microsun" conditions of tremendously high density and temperature. Taken from en: LLNL September 2002 ST&R publication. [1] Credit: courtesy of Laurence Livermore Laboratory.

Figure 41. In the current era of no underground nuclear testing, Livermore researchers participate in the nation's Stockpile Stewardship Program, which uses, in part, advanced simulation technology. Visualization engines turn the data produced by supercomputers into images displayed on individual computer monitors, large-scale screens, or massive Powerwalls, such as the one shown above. Simulations help scientists better understand how weapons materials age and how they perform under extreme conditions. Credit: courtesy of Laurence Livermore Laboratory. Credit: courtesy of Laurence Livermore Laboratory.

Bruce Goodwin, Livermore's associate director for Defense and Nuclear Technologies, says most people's immediate reaction to $E=mc^2$ is the recollection of a photo or movie of an atmospheric nuclear detonation. "A nuclear weapon is the icon for $E=mc^2$ because it presents the possibility of Armageddon," he says. "However, the deployment of nuclear weapons among the world superpowers has led to a state of deterrence, which kept the Cold War cold." Indeed, the number of deaths caused by war has dropped precipitously since 1945, when atomic bombs were dropped on Hiroshima and Nagasaki. Goodwin points out that during the Cold War, the Soviets were rational adversaries. Although they enjoyed significant advantages in conventional armaments, particularly in the early stages of the Cold War, they knew that any attack would be met with NATO nuclear weapons, if necessary. "Nuclear weapons successfully prevented world-scale war while East and West were foes," Goodwin says. Although the possibility of a crisis that could lead to an Armageddon has been dramatically reduced, the danger of a single nuclear detonation by a terrorist group or rogue nation has increased. In addition to supporting stockpile stewardship, one of Livermore's primary national security missions is to prevent nuclear weapons, materials, and know-how from reaching the wrong hands. Many scientists, like Goodwin, Livermore's associate director for Defense and Nuclear Technologies, argue that the world needs to move to a fusion economy. "Nuclear weapon designers have understood fusion for 50 years. The challenge is to harness that understanding for producing civilian energy." He notes that NIF will be the first laboratory to have controlled nuclear fusion, a critical step toward clean and abundant energy. In that light, $E=mc^2$, Goodwin says, offers to transform life on Earth because of the prospect of abundant clean energy."[185]

LIFE: Clean Energy from Nuclear Waste

Figure 42. Credit: courtesy of Laurence Livermore Laboratory.

LIFE, an acronym for Laser Inertial Fusion-Fission Energy, is an advanced energy concept under development at Lawrence Livermore National Laboratory (LLNL). Based on physics and technology developed for the National Ignition Facility (NIF), LIFE has the potential to meet future worldwide energy needs in a safe, sustainable manner without carbon dioxide emissions.

By burning nuclear waste for its fuel, LIFE has the added benefit of dramatically shrinking the planet's stockpile of spent nuclear fuel and other materials that lend themselves to nuclear proliferation.

NIF, a project of the U.S. Department of Energy's National Nuclear Security Administration, is the world's largest and highest-energy laser. On track for completion by March 2009, NIF is designed to achieve thermonuclear fusion ignition and burn in the laboratory using inertial confinement fusion (ICF) (see How to Make a Star). As such, NIF is the culmination of nearly 60 years of research into controlled fusion – capturing the energy of the sun and stars to provide clean, limitless energy on Earth.

Ignition experiments designed to accomplish NIF's goal will begin in 2010, and successful demonstration of ignition and net energy gain on NIF will be a transforming event that is likely to focus the world's attention on the possibility of ICF as a potential long-term energy option.

The Promise of Hybrid Nuclear Power

Success on NIF will serve as a springboard for LIFE, a hybrid technology that combines the best aspects of nuclear fusion, a clean, inherently safe and virtually unlimited energy source (see Inertial Fusion Energy), with fission, a carbon-free, reliable energy technology that currently provides about 16 percent of the world's electricity. Through the combination of fusion and fission, LIFE power plants could generate gigawatts of power 24 hours a day for as long as 50 years without refueling while avoiding carbon dioxide emissions, easing nuclear proliferation concerns and minimizing the concerns associated with nuclear safety and long-term nuclear waste disposal.

Existing and future inventories of spent nuclear fuel, natural and depleted uranium and weapons-grade plutonium could produce enough energy to meet the world's energy needs for hundreds to thousands of years. Besides offering energy independence and security, LIFE power plants could provide the United States with an enormous economic competitiveness edge in the energy sector in the coming decade.

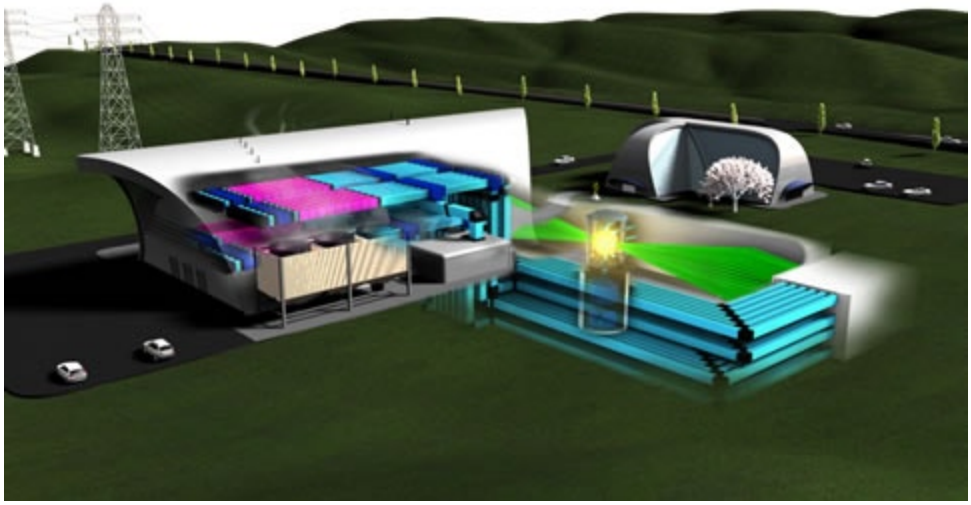

Figure 43. Artist's rendering of a LIFE power plant. LIFE power plants could squeeze the last drop of energy from nuclear waste and other fertile and fissile materials, paving the way to a safe, sustainable, carbon-free energy future. (View Video). Credit: courtesy of Laurence Livermore Laboratory.

The LIFE engine would use an ICF laser system similar to the one now under development at NIF to ignite fusion targets surrounded by a spherical blanket of subcritical fission fuel. The fuel could be one of many fertile or fissile materials, including thorium, light-water reactor spent nuclear fuel, weapons-grade plutonium, highly enriched uranium, and natural and depleted uranium. (Fertile material is nuclear material that can be converted to fissile material through the capture of a neutron, such as uranium-238.)

LIFE provides a point source of ICF-generated neutrons to extract virtually all of the energy content of its fuel. LIFE would close the nuclear fuel cycle without the need for chemical separation and reprocessing. The system would require about half as much laser energy input as a pure fusion plant, and thanks to the extra gain from the fission blanket, produce 100 to 300 times more energy than the input energy. LIFE would be proliferation-resistant and passively safe, require no uranium isotope enrichment and minimize the need for long-term geologic storage of nuclear waste.

LIFE would enable the worldwide expansion of nuclear power in a safe, secure and sustainable manner. A number of reviews and discussions of the proposal with energy experts over the last year have been positive and supportive of the concept. A LIFE development team of about 40 physicists, materials scientists, engineers and energy and national security experts from LLNL, the University of California at Berkeley and other institutions is on track to complete and review a "point design" – the target and laser features for specific experiments – and propose a path forward for LIFE in Fiscal Year 2009.

Here are links to more information on the LIFE project:

- Why Do We Need LIFE?
- Benefits & Challenges
- How LIFE Works
- Project Plan
-

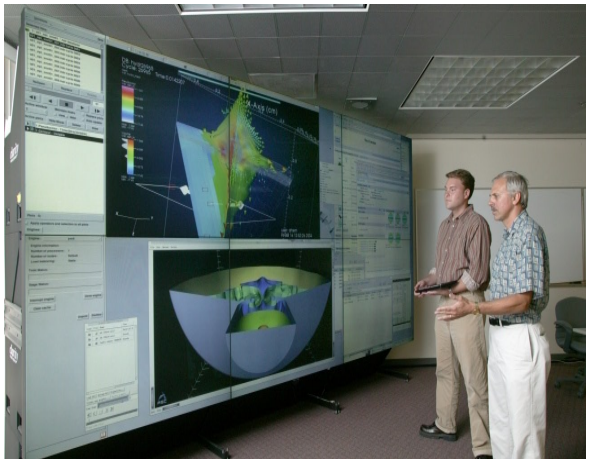

Figure 44.To visually display the complex simulations created by LLNL's supercomputers, researchers utilize multi-projector video systems that are typically both physically large as well as very high in resolution. Powerwalls, which require specialized software to display their visualizations, are used for demonstrations at high-level reviews, press conferences, and visits. Credit: courtesy of Laurence Livermore Laboratory.[186]

In general, the laser started out as a solution looking for a problem, but has now turned out to be the possible solution to all our problems. More specifically, we will be seeing the LaserFusion power solution for a laser-informed world and its knowledge workers participating in a global political knowledge-society. In the 1970's I argued in college against nuclear energy but through this laser research I changed my mind. What convinced me were two Laser Focus World articles on how: Tabletop laser induces transmutation… "of the long-lived radioactive isotope iodine-129 to the short-lived iodine-128… where… the iodine-128 half-life was determined to be 28 ± 5 min, in good agreement with the tabulated value of 25 min. And how a: Large laser tackles nuclear-waste problem… Now, European physicists have demonstrated a laser-driven approach to transmutation that has converted iodine-129, which has a half-life of 15.7 million years, into iodine-128, with a half-life of a mere 25 minutes."

A similar change of heart occurred to the author of: Power to Save the World: The Truth About Nuclear Energy by Gwyneth Cravens (Author), Richard Rhodes (Introduction). Amazon.com Review by Gwyneth Cravens on Why Going Green Means Going Nuclear. "Most of us were taught that the goal of science is power over nature, as if science and power were one thing and nature quite another. Niels Bohr observed to the contrary that the more modest but relentless goal of science is, in his words, 'the gradual removal of prejudice.' By 'prejudice,' Bohr meant belief unsupported by evidence." Pulitzer Prize-winner Richard Rhodes, author of the introduction to Power to Save the World: The Truth About Nuclear Energy by Gwyneth Craven.s "Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less." Marie Curie

My book is fundamentally about prejudice based on wrong information. I used to oppose nuclear power, even though the Sierra Club supported it. By the mid-1970s the Sierra Club turned against nuclear power too. However, as we witness the catastrophic consequences of accelerated global temperature increase, prominent environmentalists as well as skeptics like me have started taking a fresh look at nuclear energy. A large percentage of the heat-trapping greenhouse gases, especially carbon dioxide, that thaw Arctic ice and glaciers comes from making electricity, and we rely upon it every second of our lives. There are three ways to provide large-scale electricity—the kind that reliably meets the demands of our civilization around the clock. In the United States:

- 75% of that baseload electricity comes from power plants that burn fossil fuels, mainly coal, and emit carbon dioxide. Toxic waste from coal-fired plants kills 24,000 Americans annually.
- 5% comes from hydroelectric plants.
- Less than 1% comes from wind and solar power.
- 20% comes from nuclear plants that use low-enriched uranium as fuel, burn nothing, and emit virtually no CO2. In 50 years of operation, they have caused no deaths to the public.

When I began my research eight years ago, I'd assumed that we had many choices in the way we made electricity. But we don't. Nuclear power is the only large-scale, environmentally-benign, time-tested technology currently available to provide clean electricity. Wind and solar power have a role to play, but since they're diffuse and intermittent, they can't provide baseload, and they always require some form of backup--usually from burning fossil fuels, which have a huge impact on public health.

My tour of the nuclear world began with a chance question I asked of Dr. D. Richard ("Rip") Anderson. He and his wife Marcia Fernández work tirelessly to preserve open land, clean air, and the aquifer in the Rio Grande Valley. Rip, a skeptically-minded

chemist, oceanographer, and expert on nuclear environmental health and safety, told me that the historical record shows that nuclear power is cleaner, safer, and more environmentally friendly than any other form of large-scale electricity production. I was surprised to learn that:

- Nuclear power emits no gases because it does not burn anything; it provides 73% of America's clean-air electricity generation, using fuel that is tiny in volume but steadily provides an immense amount of energy.
- Uranium is more energy-dense than any other fuel. If you got all of your electricity for your lifetime solely from nuclear power, your share of the waste would fit in a single soda can. If you got all your electricity from coal, your share would come to 146 tons: 69 tons of solid waste that would fit into six rail cars and 77 tons of carbon dioxide that would contribute to accelerated global warming.
- A person living within 50 miles of a nuclear plant receives less radiation from it in a year than you get from eating one banana. Someone working in the U.S. Capitol Building is exposed to more radioactivity than a uranium miner.
- Spent nuclear fuel is always shielded and isolated from the public. Annual waste from one typical reactor could fit in the bed of a standard pickup. The retired fuel from 50 years of U.S. reactor operation could fit in a single football field; it amounts to 77,000 tons. A large coal-fired plant produces ten times as much solid waste in one day, much of it hazardous to health. We discard 179,000 tons of batteries annually--they contain toxic heavy metals.
- Nuclear power's carbon dioxide emissions throughout its life-cycle and while producing electricity are about the same as those of wind power.
- Nuclear plants offer a clean alternative to fossil-fuel plants. In the U.S. 104 nuclear reactors annually prevent emissions of 682 million tons of CO2. Worldwide, over 400 power reactors reduce CO2 emissions by 2 billion metric tons a year.

I wanted to know if what Rip was telling me was true. He took me on a tour of the nuclear world so that I could learn firsthand its risks and benefits. I visited many facilities, talked to many scientists in different disciplines, and researched the conclusions of the National Academy of Sciences and various international scientific bodies. As I learned more, I became persuaded that the safety culture that prevails at U.S. nuclear plants and the laws of physics make them a safe and important tool for addressing global warming. Clearly many of my beliefs had originated in misinformation and fear-mongering.

I've now met many people dedicated to saving the environment while supporting nuclear power as well as other green resources. This path is only logical. Nuclear power is the only large-scale, non-greenhouse-gas emitting electricity source that can be considerably expanded while maintaining only a small environmental footprint. If as a society we're going to reduce those emissions, we'll need every resource to do so, and we'll have to set aside our ideological blinkers, look at the facts, and unite to meet the greatest challenge humanity has ever faced. The power to change our world does not lie in rocks, rivers, wind, or sunlight. It lies within each of us. Gwyneth Cravens. See her interview @ http://www.npr.org/templates/story/story.php?storyId=-15654553. The Bryant Park Project, October 26, 2007 · Writer Gwyneth Cravens, an environmentalist and opponent of nuclear energy, spent the better part of the last decade researching the issues — and did an about-face. Her new book, entitled *Power to Save the World.*

In part 2 we also illustrate how the geothermal power will be connected to and managed by the Microvision VRD. Because Microvision partnered with the info-technology industry as a whole they enabled the connection of the VRD to the Home Technology Integration (HTI) system.[187] By integrating the VRD to HTI, Microvision stimulated the emergence of the LaserEmpowered Home.[188] You shall see how the most powerful laser light source in the universe will be distributed through a global photonics power line network (PPLN); laser power, video, audio and data over fiber and free space optics. This part integrates the laser's cosmic power into our smart homes. Here we announce the advent of the Petawatt laser for the photonic power line home network (PPHN). Here we specify how the LaserEmpowered HTI System will be installed, configured and powered by the Petawatt tabletop Laser star system. We will also show how it will be distributed via the photonic powerline network from JDS Uniphase.[189] You will recognize the quadruple play of the laser. In addition to the triple play (video, audio and data over the internet) offered by telecom carriers like Verizon Fios (fiber optics to the home);[190] the quad play now includes laser power transmission over the same fiber optics lines.[191]

Photonic power has evolved and accelerated the development of our capacity to harness clean laser energy. In fiber optics and free space optics, lasers are converted into electricity and back into laser. This new development is creating the new infrastructure for the future power grids. Photonic power is truly the new foundation upon which the global internet ecosystem will be delivered in the near future. We will show you in clear visual form how this quad play will serve as the foundation for our laser educational mission. Our main goal is to show you how to effectively integrate this new laser intelligence into your brain. Educate your visual cognition and prepare you for participation in the Laser Information World. Our final objective is to show you how through the free space optics of the VRD and the photonic powerline (fiber optic quad play) connection, your visual education can be augmented and MIT's superpower knowledge base integrated into your home. Telecommuting for study and work around the world will explode and participation in this global technology will be universal.

The practical unification of laser power with video, audio and data over fiber and free space optics is now upon us. However, before we delve deeper into the coherency of those visually accessible and physical faces of information, it will be necessary for us

to clear the path that will lead us to a radiant scientific career. The first obstacle that we need to clear is the incoherency or noise in the first face of information. Due to the information content explosion our life is constantly inundated with noisy messages coming from many different sources like the radio, TV, print, billboards and the World Wide Web etc. Furthermore, as the Nobel laureate in economics Herbert Simon pointed out, "a wealth of information produces a poverty of attention."[192] Today millions of kids and adults are suffering from an epidemic of attention deficit disorder.[193] This impoverishment or disempowerment of our attention, due primarily to distraction, diffusion, misdirection, misplacement and misinformation is the major source of what is known as the knowing—doing gap. Nowadays, the main problem is not information access but propaganda disinformation that creates delusions (false belief systems) and widens the gap between genuine knowledge and its praxis and between what is actually happening in the world and the false interpretations that are given about it. According to Wikipedia: Propaganda is a concerted set of messages aimed at influencing the opinions or behaviors of large numbers of people. As opposed to impartially[194] providing information, propaganda in its most basic sense presents information in order to influence its audience. Propaganda often presents facts selectively (thus lying by omission) to encourage a particular synthesis, or gives loaded messages in order to produce an emotional rather than rational response to the information presented. The desired result is a change of the cognitive narrative of the subject in the target audience to further a political agenda. 'Propaganda is the deliberate, systematic attempt to shape perceptions, manipulate cognitions, and direct behavior to achieve a response that furthers the desired intent of the propagandist.'[195]

I became acutely aware of the knowing-doing problem created by the propaganda system after reading "Know can Do! By Ken Blanchard with Paul J. Meyer and Dick Ruhe. They said something that deeply resonated inside me. "Attempting to better themselves, learn new skills, and break bad habits, people read books, attend seminars, and take training courses. But in spite of what they sincerely believe are their best efforts, their behavior doesn't change. It's an endless source of frustration for organizations and individuals." [196] Another book that brought the knowing-doing problem to the foreground of my perception and placed it into serious perspective is: The Knowing-Doing Gap: How smart companies turn Knowledge into Action by Jeffrey Pfeffer, Robert I. Sutton. "Every year, companies spend billions of dollars on training programs and management consultants, searching for ways to improve. But it's mostly all talk and no action. "Did you ever wonder why so much education and training, management consultation, organizational research and so many books and articles produce so few changes in actual management practice?" We wondered, too, and so we embarked on a quest to explore one of the great mysteries in organizational management: why knowledge of what needs to be done frequently fails to result in action or behavior consistent with that knowledge." [197]

Perhaps the greatest of MIT's pedagogic advantages is the philosophy of learning by doing, which creates in their students the vital behaviors that eliminates the knowing—doing gap. My Laser Informed program adopted this method because it enables the students to design and build their own curriculum in accordance to their own character inclination or talent as well as knowledge and skill. This establishes genuine self and social responsibility, focuses the mind on self and social ideas and leads to self and social actualization. A good example of how the MIT method of learning by doing is revolutionizing global science education is given in an article by the associated press. "Though it's found a wider audience, OpenCourseWare was originally intended for teachers. The idea wasn't just to show off MIT's geniuses but to share its innovative teaching methods. After examining an MIT course called "Machine Structures," Khan, a Pakistani professor, redesigned his lab assignments for a computer science class to get students more involved, asking them to design and build their own microprocessors. "It really encourages the students to discover and try something new," he said. "Normally the stress here is on how things work, not on creating things of your own."[198] For students and teachers the challenge of the knowing—doing problem is critical because of the knowledge intensive nature of education. It is generally easier to know about things than it is to create or act on them. Our main responsibility is therefore to convert knowledge (science or philosophy) and knowhow (engineering or art) into effective living action that is consistent with that knowledge. At the heart of this project is what Professor Steven L. Goldman identified as "the idea of systematically coupling science to technology, of coupling knowing to doing, and of using knowledge to synthesize a new world."[199] This coupling of science to technological knowhow produced techno-science which is today the primary driver of social change.

When I started my College studies in 1978, I had a strong appetite for general knowledge. I wanted to know everything and got derailed. I became a jack of all trades and master of none. My mind was so scattered that I changed curriculum 4 times. I started with liberal arts (language emphasis), passed onto business management, then onto electronics and then came back to liberal arts with science emphasis. Completely confused about what I really wanted to do, I took a leave of absence in the autumn of 1980 and so did not graduate. In the summer of 1981, I went to Venezuela as a volunteer for a Yoga community affiliated with UNESCO for just two months, but I loved it so much that I stayed for 4 years. There I taught English as a Second Language (ESL) and joined a translation team that worked on scientific and religious books from the French to Spanish and English. Through this translation work I encountered a proportional theory of visual perception that attracted my attention for a very long time. For the next two decades I continued to work independently in translation but with emphasis on bibliographic research. Through this research I realized that Einstein's quantum theory of radiation (1916) was the physical foundation for the proportional theory of visual perception[200] that I was studying, but I realized that I was still a jack of all trades and master of none.

Moreover, in December of 1994 1 discovered that Einstein's proportional constants for his 1916 theory of quantum radiation were in fact, the original ideas for the laser.[201] I found that even though the world's first laser was actually created by Theodore Maiman on May 16, 1960, it was Einstein's brilliant idea of 1916 coupled to Maiman's accomplishment that is actually changing and creating the laser informed world as we know it.[202] They in fact gave birth to the techno-science of lasers that is now the key driver to the major social changes that are synthesized by the laser informed knowledge workers of today. Finally it was precisely through this deep reflection on Einstein's radiant idea of the laser and its engineering by Maiman that I found my lifetime vocation and focus. This relation between Einstein and Maiman became for me, a living example of the systematic coupling of knowing science to doing engineering that is effectively creating the Laser Information Age. It is also important to realize that because this techno-science of lasers is theoretically informed by science it is actually an extension of the mind and not simply an extension or tool of the senses.

This focus of the laser as an extension of the intellect is the fundamental idea that gave birth to the laser informed learner via the VRD. As professor Goldman has so eloquently expressed it in his course on: The Great Scientific Ideas That Changed the World.[203]

"Scientific instruments and scientific theories have a complicated relationship, a relationship of reciprocal influence. And I think that a crucial insight, the one that I'm focusing on in this lecture, the point that I want to make sure that I get across to you in this lecture, is the idea that for instruments, as a matter of fact, it is misleading—at least misleading and I think it is an error—to think of instruments as extensions of our senses. We must appreciate the role that ideas and theories play in the design and construction of instruments, but also in the interpretation of the results, of what it is that the instruments have revealed to us. Instruments do not simply reveal what is out there. You have to make sense of what they reveal. When you look through an atomic force microscope and the computer paints a picture on the computer monitor screen of one type of atom, gold atom, sitting on top of silicon atoms, spelling out IBM in a very famous illustration recently, then that is a computer reconstruction. You're not seeing atoms. You're seeing a computer reconstruction. The computer program is based on quantum theory and it's based on very complex mathematical algorithms that interpret minute fluctuations in the electromagnetic energy at the tip of the probe of the atomic force microscope and the surface of the material that you're trying to create an image of…. If you're talking about scientific ideas that have changed the world, it is through instruments that scientists have developed theories that have changed the world, and those instruments did not drop down out of the sky. Those instruments themselves are extensions of the minds of the scientists who were trying to understand the world." [204]

My intention for the realization of a Laser Informed World is therefore to close the knowing—doing gap between the theory or idea of coherent information and its living integration via the VRD laser. Through this techno-science you extend your mental capacity by applying the coherent focused light of lasers directly into your visual and verbal experience of MIT OCW and the Open Educational Resources (OER) of the Virtual University.[205] Through this network you will also be able to contribute directly to the advancement of NIF,[206] to which MIT is a research partner along with the Laboratory for Laser Energetics (LLE) of the University of Rochester University and the Rochester Fusion Science Center.[207] An excellent program in this direction is: "The MIT Energy Initiative (MITEI),208 established in September 2006, it is an Institute-wide initiative designed to help transform the global energy system to meet the needs of the future and to help build a bridge to that future by improving today's energy systems. See the Energy Research Council Report; the foundation document for the MITEI structure and programs." This Energetic curriculum is based on science, technology and policy. We are also focused on integrating MITei superpower knowledge base (DSpace, MediaLab, Center for Collective Intelligence, OCW Consortium, MIT Video gateway etc) into your brain.209 My research found this knowledge group to be the main architects of American scientific, technological and political superpower after World War 2. Now through OCW it is democratically extending its superpower knowledge worldwide. The president of MIT met with Obama at the Whitehouse to announce a historic 39 Billion dollar public investment in energy R & D: Hockfield, Obama urge major push in clean energy research funding David Chandler, MIT News Office March 23, 2009

After taking you on a photo-tour of the grand picture of the Lambdasphere in part 2 (visual consciousness of how the earth is powered by laser fusion energy and its harnessing via geothermal sources for a democratic industry and the home), we conclude in part 3 with how the Laser Energetic Science emerged from Einstein's proportional vision of light. In part 2 we described and illustrated how the super hot laser fusion and geothermal power can be connected to our photonics or fiber infrastructure by conversion and amplification of lasers. The 3rd part in turn focuses more on how Einstein's proportional vision of light was transduced into our Laser Informed Vision. From Carver Mead's vector potential to the action potential of the brain we see how Banesh Hoffmann and Helen Dukas' proportional formulation of Einstein's lightning example of relativity theory is integrated into his vision of the quantum light of 1916. This laser enlightened penetration into the quantum world led Einstein 8 years later (1924) to the supercooled Bose-Einstein Condensate (BEC is a coherent laser-like state of atomic matter). According to Wikipedia; "a Bose–Einstein condensate (BEC) is a coherent state of matter of bosons confined in an external potential and cooled to temperatures very near to absolute zero (0 K or -273.15°C). Under such supercooled conditions, a large fraction of the atoms collapse into the lowest quantum state of the external potential, at which point quantum effects become apparent on a macroscopic scale. BEC was predicted in 1924 by Albert Einstein, who built on the work of Satyendra Nath Bose, the condensation occurs when individual atoms meld into a "super atom" behaving as a single entity at just a few hundred billionths of a degree above absolute zero. The 71-year quest to confirm Bose and Einstein's theory was likened by many physicists to the search for the mythical Holy Grail. The BEC allows scientists to study the strange and extremely small world of quantum physics as if they are looking through a giant magnifying glass. Its creation established a new branch of atomic physics that has provided a treasure- trove of scientific discoveries." [210]

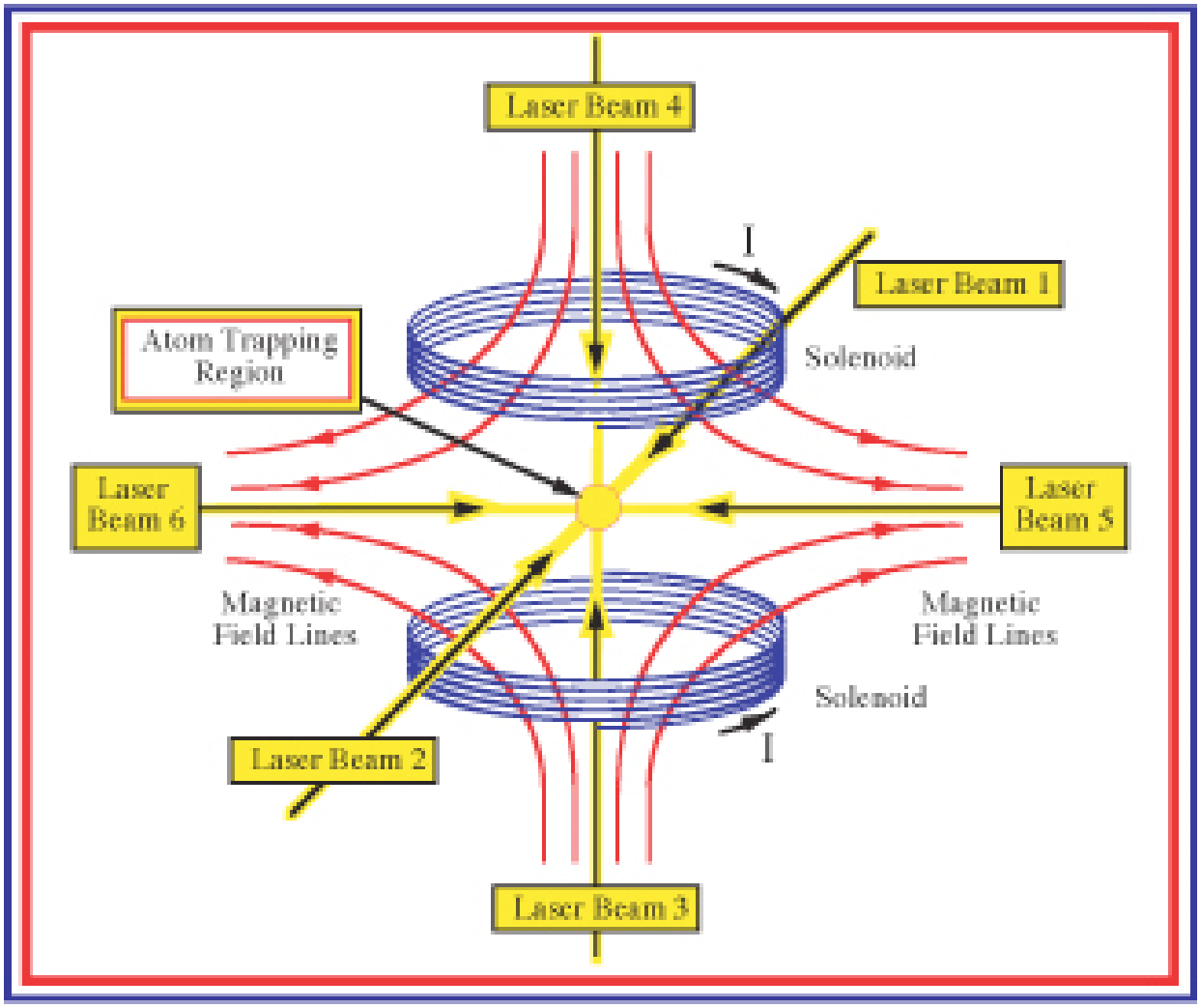

Figure 45. Setup for the Magneto Optical Trap (MOT) showing the coils and laser beams that are adopted for BEC creation. Credit Courtesy of Professor Andrew James MURRAY @ Manchester University, UK.[211]

Today BEC has yielded the Bose-Einstein structure of perception (laser proportional vision of our quantum brains) that is magnifying our coherent image of the universe with the atomic laser on the microscopic scale and the laser stars on the macroscopic scale. BEC research has connected atomic teleportation to photon entanglement and has firmly established the foundation for the quantum computer. "A quantum computer is any device for computation that makes direct use of distinctively quantum mechanical phenomena, such as superposition and entanglement, to perform operations on data. In a classical (or conventional) computer, information is stored as bits; in a quantum computer, it is stored as qubits (quantum bits). The basic principle of quantum computation is that the quantum properties can be used to represent and structure data and that quantum mechanisms can be devised and built to perform operations with this data.[1]"[212]

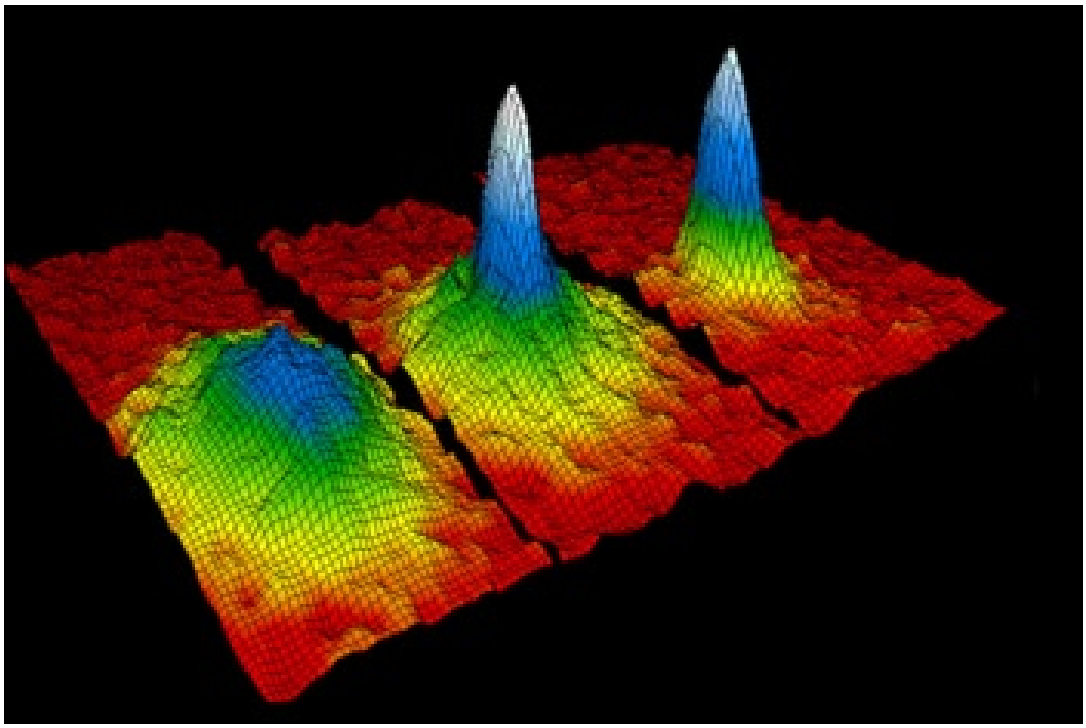

Figure 46. Bose-Einstein Condensation at 400, 200, and 50 nano-Kelvins (above absolute zero). Credit: courtesy of JILA[213]

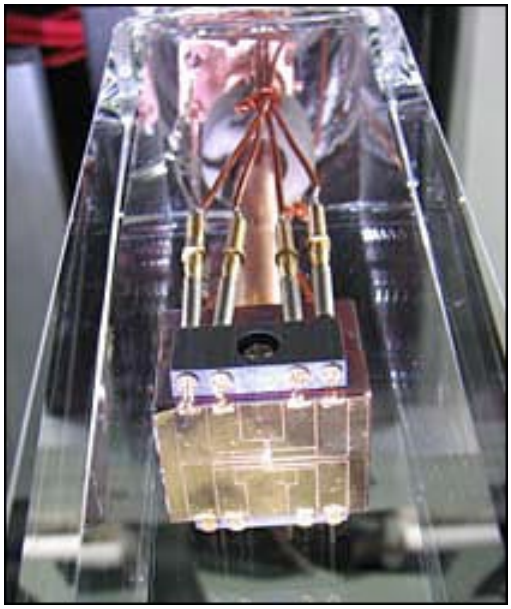

Figure 47. China's atom-chip system. SHANGHAI, China, Dec. 16, 2008 -- Researchers in China have successfully developed the country's first atom-chip system -- a milestone in ultracold atom research and quantum information storage technologies -- and at least one Nobel Prize laureate (the German MIT professor and physicist Wolfgang Ketterle) is impressed. (Photo: Chinese Academy of Sciences).[214]

Through this revolutionary guide to higher online education you will course through three parts that are designed to help you create a genuine livelihood in the emerging Laser Information World. It will enable you to democratize (equalize) education and participate in the emerging political knowledge economy (part 1). It is focused on Laser empowering you for collaboration in the ultimate solution to the energy problem of global warming via Fusion/Fission and Geothermal Power (part 2) for industry and the home. And it will laser enlightened you about visual cognition upgrades and Einstein's Laser Informed Vision (part 3). As I was groping with the abstract mathematics of quantum physics I realized how important formal schooling truly is. So I decided to go back to college, but college in the beginning of the 21st century is very different than it was in the 1970's. Back then college was free thanks to Pell grants and tuition assistance programs (TAP), now it costs hundreds of thousands of dollars ($300,000 for 5 years @ MIT). So before I went back I had to research all my options. This book is the result of those findings. After decades of reading and translating other author's books, I decided to research, write and publish my findings in my own book. Similarly after five decades of studying with many schools of thought I found a way of creating a networked school (LaserEdu.org) that is connected to the best schools of thought (The Virtual University).

In this book, you as a Laser Informed Learner are invited to participate in the design and realization of the Open Resource Based Economy (ORBE). The initial architectural model was envisioned by Jacque Fresco and his Venus Project. ORBE is realized with a clean LaserFusion and Geothermal power system that we can harness via MIT's superpower knowledge base and the Virtual University. UNESCO's VU integrates all the OCW Consortia programs and Open educational resources that are relevant for a radiant career in the ORBE. This book will also help you convert MIT OCW into an accredited online degree via Excelsior College. It is also designed to help you solve the cognitive, vocational and financial problems that impede the successful realization of the ORBE. You will also be seeing how the Libertarian Socialist educator Noam Chomsky at MIT clarified my understanding of the political knowledge economy that is emerging on the World Wide Web. Through this study I finally realized that MIT's stimulus for the rise of the ORBE via OCW is truly based on Libertarian Socialism.

Part 1. Noam Chomsky's Libertarian Socialism, Peter F. Drucker's Knowledge Management Principles and MIT's Democratization of Higher Education for the ORBE.

1.1 Noam Chomsky: A Libertarian Socialist Educator at MIT

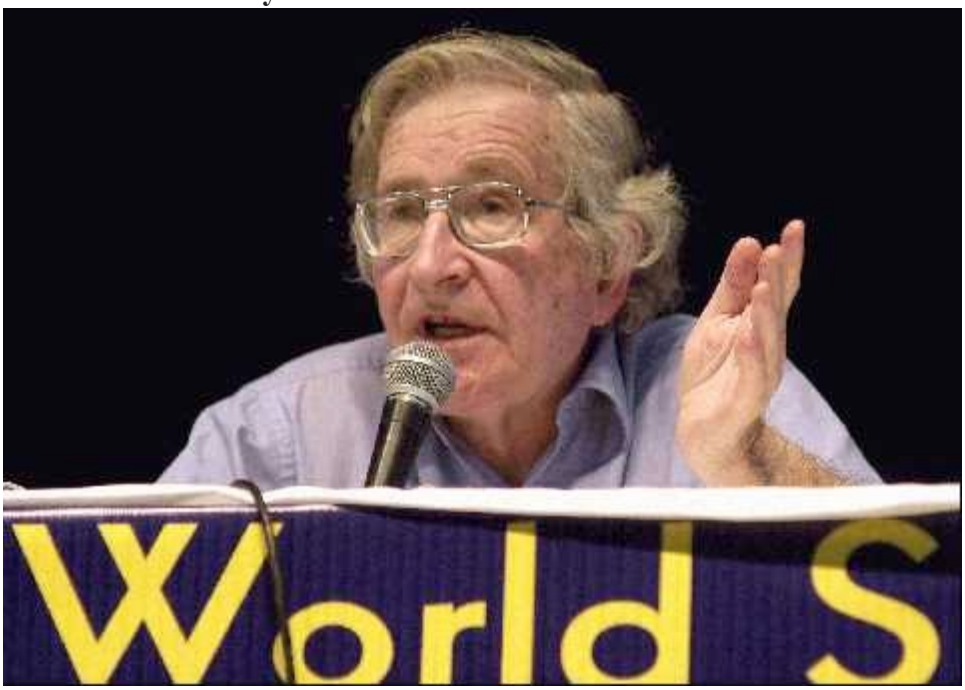

Figure 48. Noam Chomsky, at the World Social Forum in Brazil - 2003. Chomsky is a widely known intellectual, political activist, and critic of the foreign policy of the United States and other governments. Chomsky describes himself as a libertarian socialist, a sympathizer of anarcho-syndicalism and is considered to be a key intellectual figure within the left wing of American politics. "A consistent libertarian must oppose private ownership of the means of production and the wage slavery which is a component of this system, as incompatible with the principle that labor must be freely undertaken and under the control of the producer".[14]215 He believes that libertarian socialist values exemplify the rational and moral extension of the classical liberal and radical humanist ideas to an advanced industrial context. [1]

As you have seen in the introduction, the Laser Information Age is the result of a multiplicity of laser information technologies. This techno-science is culminating in a LaserFusion and Laser Drilled-Geo-thermal power system that is designed to harness unlimited clean energy. This photonic power will be distributed through fiber and free space optical systems that encircle and interpenetrate the entire biosphere culminating in the integration with our brains. Now anyone who is willing and able can participate in this grand project thanks to the Virtual University, MIT OCW consortia and the NIF. Now the Laser Informed Learner has all the educational tools for research and development of that photonic power. Access to a new political knowledge economy based on Libertarian Socialism is also emerging as the proper democratic wealth creation and distribution system for this light. The ultimate question of who is this laser informed learner that is undergoing the process of education is of utmost importance. We now have a great body of scientific evidence supporting the libertarian-socialist theory of human nature. In this context it is the healthy interdependent relationship between the individual and the social approach to the learning process that is essential. In other systems there is subjugation or abuse of the social by the individual (state capitalism) and coercion of the individual by the social (state socialism).

According to Wikipedia; "Libertarian socialism is a group of political philosophies that aim to create a society without political, economic or social hierarchies – a society in which all violent or coercive institutions would be dissolved, and in their place every person would have free, equal access to tools of information and production, or a society in which such coercive institutions and hierarchies were drastically reduced in scope." This equality and freedom would be achieved through the abolition of authoritarian institutions such as private property,[2] in order that direct control of the means of production and resources will be shared by the working class and society as a whole. Libertarian socialism also constitutes a tendency of thought that informs the identification, criticism and practical dismantling of illegitimate authority in all aspects of social life. Accordingly libertarian socialists believe that "the exercise of power in any institutionalized form – whether economic, political, religious, sexual or educational – brutalizes both the wielder of power and the one over whom it is exercised."[3]216

The role of the educator in this tradition is akin to that of a Gardner who plants a seed or his genes and protects its growth by providing a healthy environment (sunlight, good soil and water); analogically in a school or home the teacher or parent provides a propitious intellectual environment and opportunity for the students' inquiry and creativity. The gardener provides for the seed and recognizes the identity or the type of information the seed carries (flower, plant or fruit), he or she enables it to be what it is. Above of all, the Gardner recognizes the intrinsic value of the seed and from there is derived his or her appreciation for its life. This idea is also consistent with the etymology of the word education which comes from the root word e-duce which means, to draw forth or bring out the info-knowledge or moral potential that is latent in the brain. It is a process of elicitation and development or cultivation, from where culture is derived. Thomas Jefferson's—who had correspondence with Humboldt—proposal for a public education system that would honor those inalienable human rights (Liberty, Equality and the Pursuit of happiness) is directly linked—but with some critical imperial reservation—to Noam Chomsky's enlightened libertarian socialist tradition. "Chomsky traces modern-day American imperialism to its earliest roots, 25 years before the American Revolution. If it weren't for British forces preventing America's expansion, claims Chomsky, Canada wouldn't exist today." 217

Indoctrination in this tradition is the opposite of education. In both the religious and the empiricist version, the indoctrinator tries to emotionally persuade a person because he or she assumes that the human mind is a worthless (corrupted sinner or an empty vessel) blank slate.[218] According to Wikipedia "Indoctrination is the process of inculcating ideas, attitudes, cognitive strategies or a professional methodology. It is often distinguished from education by the fact that the indoctrinated person is expected not to question or critically examine the doctrine they have learned. As such it is used pejoratively. Instruction in the basic principles of science, in particular, cannot properly be called indoctrination, in the sense that the fundamental principles of science call for critical self-evaluation and skeptical scrutiny of one's own ideas or assumptions… Noam Chomsky remarks, "For those who stubbornly seek freedom, there can be no more urgent task than to come to understand the mechanisms and practices of indoctrination. These are easy to perceive in the totalitarian societies, much less so in the system of 'brainwashing (coercive persuasion or thought control) under freedom' to which we are subjected and which all too often we serve as willing or unwitting instruments." [2][219]This is where Chomsky's doctrinal analysis of science, education, politics, business and the media shows how elites in those fields abuse language and knowledge. Chomsky also liberated my mind from the propaganda system of the corporate media, of religion in general and the deceptive politics of the USA in particular.[220] In the following analysis Wikipedia gives us an accurate summary of Chomsky's penetrating vision of the propaganda system.

Propaganda, American-style By Noam Chomsky

Pointing to the massive amounts of propaganda spewed by government and institutions around the world, observers have called our era the age of Orwell. But the fact is that Orwell was a latecomer on the scene. As early as World War I, American historians offered themselves to President Woodrow Wilson to carry out a task they called "historical engineering," by which they meant designing the facts of history so that they would serve state policy. In this instance, the U.S. government wanted to silence opposition to the war. This represents a version of Orwell's 1984, even before Orwell was writing.

In 1921, the famous American journalist Walter Lippmann said that the art of democracy requires what he called the "manufacture of consent." This phrase is an Orwellian euphemism for thought control. The idea is that in a state such as the U.S. where the government can't control the people by force, it had better control what they think. The Soviet Union is at the opposite end of the spectrum from us in its domestic freedoms. It's essentially a country run by the bludgeon. It's very easy to determine what propaganda is in the USSR: what the state produces is propaganda.

That's the kind of thing that Orwell described in 1984 (not a very good book in my opinion). 1984 is so popular because it's trivial and it attacks our enemies. If Orwell had dealt with a different problem-- ourselves--his book wouldn't have been so popular. In fact, it probably wouldn't have been published.

In totalitarian societies where there's a Ministry of Truth, propaganda doesn't really try to control your thoughts. It just gives you the party line. It says, "Here's the official doctrine; don't disobey and you won't get in trouble. What you think is not of great importance to anyone. If you get out of line we'll do something to you because we have force." Democratic societies can't work like that, because the state is much more limited in its capacity to control behavior by force. Since the voice of the people is allowed to speak out, those in power better control what that voice says--in other words, control what people think. One of the ways to do this is to create political debate that appears to embrace many opinions, but actually stays within very narrow margins. You have to make sure that both sides in the debate accept certain assumptions--and that those assumptions are the basis of the propaganda system. As long as everyone accepts the propaganda system, the debate is permissible.

The Vietnam War is a classic example of America's propaganda system. In the mainstream media--the New York Times, CBS, and so on-- there was a lively debate about the war. It was between people called "doves" and people called "hawks." The hawks said, "If we keep at it we can win." The doves said, "Even if we keep at it, it would probably be too costly for use, and besides, maybe we're killing too many people." Both sides agreed on one thing. We had a right to carry out aggression against South Vietnam. Doves and hawks alike refused to admit that aggression was taking place. They both called our military presence in Southeast Asia the defense of South Vietnam, substituting "defense" for "aggression" in the standard Orwellian manner. In reality, we were attacking South Vietnam just as surely as the Soviets later attacked Afghanistan.

Consider the following facts. In 1962 the U.S. Air Force began direct attacks against the rural population of South Vietnam with heavy bombing and defoliation . It was part of a program intended to drive millions of people into detention camps where, surrounded by barbed wire and armed guards, they would be "protected" from the guerrillas they were supporting--the "Viet Cong," the southern branch of the former anti-French resistance (the Vietminh). This is what our government calls aggression or invasion when conducted by some official enemy. The Saigon government had no legitimacy and little popular support, and its leadership was regularly overthrown in U.S.-backed coups when it was feared they might arrange a settlement with the Viet Cong. Some 70,000 "Viet Cong" had already been killed in the U.S.-directed terror campaign before the outright U.S. invasion took place in 1972.

Like the Soviets in Afghanistan, we tried to establish a government in Saigon to invite us in. We had to overthrow regime after regime in that effort. Finally we simply invaded outright. That is plain, simple aggression. But anyone in the U.S. who thought that our policies in Vietnam were wrong in principle was not admitted to the discussion about the war. The debate was essentially over tactics.

Even at the peak of opposition to the U.S. war, only a minuscule portion of the intellectuals opposed the war out of principle--on the grounds that aggression is wrong. Most intellectuals came to oppose it well after leading business circles did--on the "pragmatic" grounds that the costs were too high.

Strikingly omitted from the debate was the view that the U.S. could have won, but that it would have been wrong to allow such military aggression to succeed. This was the position of the authentic peace movement but it was seldom heard in the mainstream media. If you pick up a book on American history and look at the Vietnam War, there is no such event as the American attack on South Vietnam. For the past 22 years, I have searched in vain for even a single reference in mainstream journalism or scholarship to an "American invasion of South Vietnam" or American "aggression" in South Vietnam. In America's doctrinal system, there is no such event. It's out of history, down Orwell's memory hole.

If the U.S. were a totalitarian state, the Ministry of Truth would simply have said, "It's right for us to go into Vietnam. Don't argue with it." People would have recognized that as the propaganda system, and they would have gone on thinking whatever they wanted. They would have plainly seen that we were attacking Vietnam, just as we can see the Soviets are attacking Afghanistan.

People are much freer in the U.S., they are allowed to express themselves. That's why it's necessary for those in power to control everyone's thought, to try and make it appear as if the only issues in matters such as U.S. intervention in Vietnam are tactical: Can we get away with it? There is no discussion of right or wrong.

During the Vietnam War, the U.S. propaganda system did its job partially but not entirely. Among educated people it worked very well. Studies show that among the more educated parts of the population, the government's propaganda about the war is now accepted unquestioningly. One reason that propaganda often works better on the educated than on the uneducated is that educated people read more, so they receive more propaganda. Another is that they have jobs in management, media, and academia and therefore work in some capacity as agents of the propaganda system--and they believe what the system expects them to believe. By and large, they're part of the privileged elite, and share the interests and perceptions of those in power.

On the other hand, the government had problems in controlling the opinions of the general population. According to some of the latest polls, over 70 percent of Americans still thought the war was, to quote the Gallup Poll, "fundamentally wrong and immoral, not a mistake." Due to the widespread opposition to the Vietnam War, the propaganda system lost its grip on the beliefs of many Americans. They grew skeptical about what they were told. In this case there's even a name for the erosion of belief. It's called the "Vietnam Syndrome," a grave disease in the eyes of America's elites because people understand too much.

Let me gives on more example of the powerful propaganda system at work in the U.S.--the congressional vote on contra aid in March 1986. For three months prior to the vote, the administration was heating up the political atmosphere, trying to reverse the congressional restrictions on aid to the terrorist army that's attacking Nicaragua. I was interested in how the media was going to respond to the administration campaign for the contras. So I studied two national newspapers, the Washington Post and the New York Times. In January, February, and March, I went through every one of their editorials, opinion pieces, and the columns written by their own columnists. There were 85 pieces. Of these, all were anti-Sandinista. On that issue, no discussion was tolerable.

There are two striking facts about the Sandinista government, as compared with our allies in Central America--Honduras, Guatemala, and El Salvador. One is that the Sandinista government doesn't slaughter its population. That's a well-recognized fact. Second, Nicaragua is the only one of those countries in which the government has tried to direct social services to the poor. This too, is not a matter of debate; it is conceded on all sides to be true.

On the other hand, our allies in Guatemala and El Salvador are among the world's worst terrorist states. So far in the 1980s, they have slaughtered over 150,000 of their own citizens, with U.S. support. These nations do little for their populations except torture,

terrorize, and kill them. Honduras is a little different. In Honduras, there's a government of the rich that robs the poor. It doesn't kill on the scale of El Salvador or Guatemala, but a large part of the population is starving to death.

So in examining the 85 editorials, I also looked for these two facts about Nicaragua. The fact that the Sandinistas are radically different from our Central American allies in that they don't slaughter their population was not mentioned once. That they have carried out social reforms for the poor was referred to in two phrases, both buried. Two phrases in 85 columns on one crucial issue, zero phrases in 85 columns on another.

That's really remarkable control over thought on a highly debated issue. After that I went through the editorials on El Salvador and Nicaragua from 1980 to the present; it's essentially the same story. Nicaragua, a country under attack by the regional superpower, did on October 15, 1985, what we did in Hawaii during World War II: instituted a state of siege. There was a huge uproar in the mainstream American press--editorials, denunciations, claims that the Sandinistas are totalitarian Stalinist monsters, and so on.

Two days after that, on October 17, El Salvador renewed its state of siege. Instituted in March 1980 and renewed monthly afterwards, El Salvador's state of siege was far more harsh than Nicaragua's. It blocked freedom of movement and virtually all civil rights. It was the framework within which the U.S.-trained and -organized army has carried out torture and slaughter.

The New York Times considered the Nicaraguan state of siege a great atrocity. The Salvadoran state of siege, far harsher in its methods and it application, was never mentioned in 160 New York Times editorials on Nicaragua and El Salvador, up to now [mid-1986, the time of this interview].

We are often told the country is a budding democracy, so it can't possibly be having a state of siege. According to news reports on El Salvador, Duarte is heading a moderate centrist government under attack by terrorists of the left and of the right. This is complete nonsense. Every human rights investigation, even the U.S. government in private, concedes that terrorism is being carried out by the Salvadoran government itself. The death squads are the security forces. Duarte is simply a front for terrorists. But that is seldom said publicly. All this falls under Walter Lippmann's notion of "the manufacture of consent." Democracy permits the voice of the people to be heard, and it is the task of the intellectual to ensure that this voice endorses what leaders perceive to be the right course. Propaganda is to democracy what violence is to totalitarianism. The techniques have been honed to a high art in the U.S. and elsewhere, far beyond anything that Orwell dreamed of. The device of feigned dissent (as practiced by the Vietnam- era "doves," who criticized the war on the grounds of effectiveness and not principle) is one of the more subtle means, though simple lying and suppressing fact and other crude techniques are also highly effective.[221]

Mass media analysis

"Another focus of Chomsky's political work has been an analysis of mainstream mass media (especially in the United States), which he accuses of maintaining constraints on dialogue so as to promote the interests of corporations and the government.

Edward S. Herman and Chomsky's book Manufacturing Consent: The Political Economy of the Mass Media explores this topic in depth, presenting their "propaganda model" of the news media with several detailed case studies in support of it. According to this propaganda model, more democratic societies like the U.S. use subtle, non-violent means of control, unlike totalitarian systems, where physical force can readily be used to coerce the general population. In an often-quoted remark, Chomsky states that "propaganda is to a democracy what violence is to a totalitarian state" (Media Control).[222]

The model attempts to explain such a systemic bias in terms of structural economic causes rather than a conspiracy of people. It argues the bias derives from five "filters" that all published news must pass through which combine to systematically distort news coverage.

1. The first filter, ownership, notes that most major media outlets are owned by large corporations.
2. The second, funding, notes that the outlets derive the majority of their funding from advertising, not readers. Thus, since they are profit-oriented businesses selling a product — readers and audiences — to other businesses (advertisers), the model would expect them to publish news which would reflect the desires and values of those businesses.
3. In addition, the news media are dependent on government institutions and major businesses with strong biases as sources (the third filter) for much of their information.
4. Flak, the fourth filter, refers to the various pressure groups which go after the media for supposed bias and so on when they go out of line.
5. Norms, the fifth filter, refer to the common conceptions shared by those in the profession of journalism.[23]

The model therefore attempts to describe how the media form a decentralized and non-conspiratorial but nonetheless very powerful propaganda system that is able to mobilize an "élite" consensus, frame public debate within "élite" perspectives and at the same time give the appearance of democratic consent."[223]

Chomsky's Libertarian Social Democracy also informed my politics of Laser Energetics and its application to the emerging photonics power grid. Through Chomsky's libertarian socialism and the Creative Commons copyright Law[224] that is emerging on the internet, we can democratically and globally transfer to all humanity, the intellectual and social value of the most powerful light in the universe.[225] For Chomsky's most enlightened description of the historical role of the state titled: Government in the Future, the editorial review at Amazon.com gives us a very accurate summary. "What is the role of the state in an advanced industrial society? In this classic talk delivered at the Poetry Center, New York, on February 16, 1970, Noam Chomsky articulates a clear, uncompromising vision of social change. Chomsky contrasts the classical liberal,[226] libertarian socialist,[227] state socialist[228] and state capitalist[229] world views and then defends a libertarian socialist vision as "the proper and natural extension . . . of classical liberalism into the era of advanced industrial society." In his stirring conclusion, Chomsky argues, "We have today the technical and material resources to meet man's animal needs. We have not developed the cultural and moral resources or the democratic forms of social organization that make possible the humane and rational use of our material wealth and power. Conceivably, the classical liberal ideals as expressed and developed in their libertarian socialist form are achievable. But if so, only by a popular revolutionary movement, rooted in wide strata of the population and committed to the elimination of repressive and authoritarian institutions, state and private. To create such a movement is a challenge we face and must meet if there is to be an escape from contemporary barbarism." (Amazon.com)[230]

In Hegemony or Survival: Americas Quest for global Dominance,[231] Chomsky informs us with high moral strength that America's empire of military bases (737 bases in over130 countries and over 950 here at home)[232] with its intention to rule the world by force is the single biggest threat to the survival of the species. The military is the most coercive institution in the world because it uses indoctrination as its foundation for teaching and the rule of force to impose its will on others. This institution is anti-democratic or hierarchical at its core. But for Chomsky the military industrial complex is not just a war machine it is actually "the core of the modern economy" in the state capitalist system of the USA. The Hi-tech industry (the computer, internet and lasers etc) is a product of this complex. The military- executive-judicial-congressional-academic and corporate media complex[233] is the key to understand how massive amounts of wealth are transferred from the public to private Corporations, without the peoples' consent. The military Keynesianism[234] of The Complex is the key to understand how the USA really works beyond the mis-education[235] of school and the free market fantasies of the mass media.[236]

According to Wikipedia, "Keynesian economics (pronounced /□ke□nziən/, "kane-zeean"), also Keynesianism and Keynesian Theory, is an economic theory based on the ideas of twentieth-century British economist John Maynard Keynes. The state, according to Keynesian economics, can help maintain economic growth and stability in a mixed economy, in which both the public and private sectors play important roles. Keynesian economics seeks to provide solutions to what some consider failures of laissez-faire economic liberalism, which advocates that markets and the private sector operate best without state intervention. The theories forming the basis of Keynesian economics were first presented in The General Theory of Employment, Interest and Money, published in 1936."[237]

This is why the Libertarian Socialist educator provides a critical intellectual defense for the Laser Informed Learner. Through this intellectual guard you can cut through the propaganda system and find the truth. The Libertarian Socialist world view leads us to the interdependent examination of the Individual and the social as the fundamental criteria upon which you will design and build your entire curriculum so that it will be based on an authentic foundation. Again, it is not that the individual is more important than the social or that the social is more important than the individual, it is that both are equally important and inter-dependant. Our society of organizations and the world needs the best of yourself as a knowledge worker and only through the discovery of the best in you or as Plato would say the good, the true and the beautiful within you, that you will be able to offer and connect it to all of mankind. But it is only through the proper social-economic and political structure that humanity as a whole will get access to all the resources that are essential for its fulfillment.

1. 2 The Laser Informed Learner's Strengthsquest with Drucker's Knowledge Management Practice and the Conversion of Open Educational Resources (OER) into an Accredited Online Degree via Excelsior College

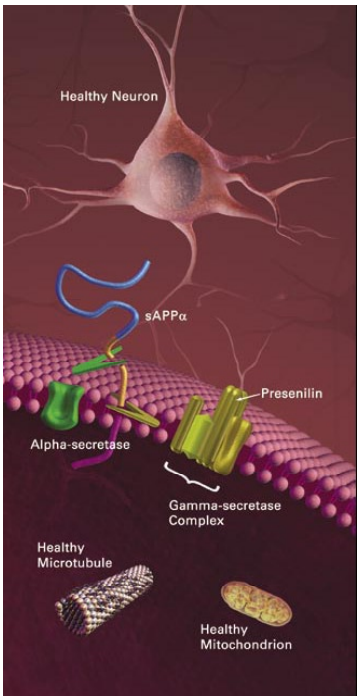

Figure 49. Neurogenesis (birth of neurons) is the process by which neurons are created. Most active during pre-natal development, neurogenesis is responsible for populating the growing brain. One exciting recent development is the discovery that the brain can generate new neurons throughout the life-cycle in a process called neurogenesis. Credit courtesy of NIH.[238]

In this section we will help you navigate through a self-discovery process that will magnify who you are, where your potential resides and what you ought to do in order to customize the higher intellectual powers that be for self-realization and socialization. Here we address the problem of identifying your vocation through a solution called Strengthsquest. "Strengthsquest is Gallup's strengths development program for college-age students. It gives students the opportunity to develop based on their strengths rather than their weaknesses. In other words, it helps students learn what they do best, and then build their lives on those talents."[239] According to Gallop, statistically 80% of graduates don't work in the field that they studied, because of miss-direction, misplacement, lack of self-knowledge or financial obligations. The consequence of career disorientation is massive work dissatisfaction. In a survey of 10 million people gallop found that 70% were not positively productive or emotionally engaged at work. Strengthsquest is based on the Strengthsfinder (@ https://www.strengthsfinder.com/113647/-Homepage.aspx.) [240] a self-assessment test developed by the Gallup Group. The test was the result of a 40-year research project that they carried out in Fortune 500 companies. With the object of understanding high performance, Gallup discovered the important distinction between talent, knowledge and skills. Talent is the embedded or innate knowledge of your brain (genetic sources) that enables consistent high performance. Knowledge is systematically interpreted awareness of internal or external systems of information (epigenetic sources). Skill is the acquired ability to recreate a learned performance like reading, writing or programming etc.

Since my educational mission is to draw out and extend the maximum capacity of the individual and the collective brain, I was drawn to this program because it's not only very precise in its assessment; it also helps you design a curriculum pathway that is directly connected to your strengths. Strengthquest thereby coordinates the genetic; the epigenetic or environmental influence and applies it skillfully to a chosen career. Neurologically as you develop during the first phases of your life your brain inflates itself during those first years and then it prunes itself. During the pruning phase it contracts and sheds or eliminates a lot of brain cells. What you are left with is a series of pathways or synaptic wiring in your brain that highlights certain capacities and diminishes others. (See: The Brain: Our Sense of Self @ http://science.education.nih.gov/supplements/nih4/self/guide/nih_self_curr-supp.pdf.)[241] What is highlighted or left intact is your talents or what your brain's capacity does best. Strengthfinder characterizes and delineates in a clearly articulated language the meaning of those pathways. The result of the test helps you identify where your talents are located so that you can focus your strengths in an academic area that is most in harmony with your capacity.

This philosophy of identifying your strengths or talents and coordinating it with external knowledge and skills that are going to be acquired through higher educational programs, gives you the most productive way of engaging yourself thereby allowing for the best of you to emerge. This is why we focus on guiding our students through this program before they go ahead and design a curriculum with MIT OCW or the Virtual University. It is absolutely crucial that you identify your potential before you draw out the best of who you are through any higher educational process. We believe that this is the most harmonious way to develop and actualize your greatest potential. In this section we recommend that you connect to the online Strengthquest community. The community is now actively working to help students identify their talents and apply them to their chosen careers. There are a lot of resources and over 400 colleges in the USA who are adopting this methodology. Here we emphasize not only the career characteristics that are derived from the Strengthfinder exams but also the necessity of energy management on 4 levels. (See: The Power of Full Engagement: Managing Energy, Not Time, Is the Key to High Performance and Personal Renewal by Jim Loehr and Tony Schwartz.[242] We coordinate the physical, mental, emotional and ethical values that are essential for unleashing the optimal energy capacity of your being.

Through this program you will liberate the full strength of your character. To accomplish your educational goals I recommend that you assess the health of your body, emotions, mind, and your ethical values or moral sense. For your ethical health please take the Moral Sense Test (MST) @ http://www.wjh.harvard.edu/~mnkylab/. Please read or listen to: The Ethical Brain Unabridged by Michael Gazzaniga Narrated by Patrick Lawlor. The enjoyable, thought-provoking book will introduce readers to complex interplay between neuroscience and ethics. (Science)."None of the ideas are necessarily new in The Ethical Brain, but it is still an easy-to-read survey that treats the reader to an overview of the entire set of issues pertaining to morals and the brain." (Science and Theology News)."Gazzaniga eschews easy answers in exploring the potential and limits of neuroscience." (USA Today)."[The Ethical Brain] does not address practical ethical questions that may confront clinicians in daily practice. Nevertheless, the strength...is the author's perspective as a neuroscientist, which will introduce the reader to complex aspects of neuroscience in relation to behavior society." (Journal of the American Medica Association). In The Ethical Brain, [Gazzaniga] does not shy away from taking on the loaded question...when does an embryo become a human being--"one of us"? His thoughtful discussion makes The Ethical Brain a worthwhile read." (San Jose Mercury)."Michael S. Gazzaniga takes an unflinching lok at the interface between neuroscience and ethics, and offers his own thoughtful perspective on some of the tough questions. (Media Times Review Blog).The Ethical Brain provides us with cautions--prominent among them that 'neuroscience will never find the brain correlate of responsibility, because that is something we ascribe to humans--to people--not to brains. It is a moral value we demand of our fellow, rule-following human beings.' This statement--coming as it does from so eminent a neuroscientist--is a cultural contribution in itself." (The New York Times).Will increased scientific understanding of our brains overturn our beliefs about moral and ethical behavior? How will increasingly powerful brain imaging technologies affect the ideas of privacy and of self-incrimination? Such thought-provoking questions are rapidly emerging as new discoveries in neuroscience have raised difficult legal and ethical dilemmas. Michael Gazzaniga, widely considered to be the father of cognitive neuroscience, investigates with an expert eye some of these controversial and complex issues in The Ethical Brain.

All 4 dimensions of your being need to be critically assessed so that you can actualize the fullest potential of your being. These 4 parts of your being will be explored through what is now called positive psychology. It is important to realize at this junction of the program that education is not about preparing for a job in a market place. Genuine education is about actualization of your fullest potential. It is about recognizing who you are and what you are capable of doing and extending that capacity to its optimal performance. This mode of being will naturally lead you to the fulfillment of various roles in society. These roles will solve many of our current problems, but only if you are operating from your utmost capability. It is also my understanding that when you study, live and work within a field that you are truly passionate about, the fruits of your labor will be the fruits of love. This labor of love will produce the most wonderful results and the journey or the process as a means to an end will be as meaningful and enjoyable as the destination. Ask yourself what's my learning style? It is extremely important that you acknowledge your style of learning. Your recognition of the visual, audio or kinesthetic style of learning will enhance your ability to integrate the newly acquired knowledge. Assess yourself now @ http://www.usd.edu/trio/tut/ts/style.html.[243] Our goal is for you to enjoy the process of learning itself so that you reach your goals, not only in the future expectation of enjoyment but through the process itself. The first principle of our great work as stated in the Greek aphorism; to know thyself is essential for this project. In order to embark on a successful educational venture or career, the fundamental criteria should be to first know where your strengths reside for that particular career.

We now consider the four parts of being that will be employed in the realization of your educational potential. We start our project with a healthy brain because it's not only the most tangible but more importantly it is the foundation of our being. I recommend you read and listen to: The Omega Rx Zone: The Miracle of the New High-Dose Fish Oil by Barry Sears @ http://www.zonediet.com/Home/-tabid/36/Default.aspx. It is very important to realize that 60% of our brain tissue is fat and the key intelligence areas like the retina, the visual cortex and the grey matter is Omega 3 (DHA) type fat. I studied and practice this program because on the theoretical side it is evidence based nutrition and physiological self-knowledge. Dr. Sears shows you how food is actually converted to biochemistry (hormones) or your bio-internet signaling system. On the living side, I took a blood test (lipid profile" test or cholesterol level screening) and discovered that I was in serious trouble because my triglyceride-HDL ratio was very high (a precondition for heart disease) but after following Dr. Sears advise saying that I should balance my fat, protein and carbohydrate intake with high quality macro-nutrients (whole foods) I was back on track. I verified the healthy results with the AA/EPA ratio blood test that he recommends and I was stunned by the results. "With the right balance of protein, carbohydrates and fats, you can control three major hormones generated by the diet – insulin, glucagon and eicosanoids. Insulin – A storage hormone. Excess insulin makes you fat and keeps you fat. It also accelerates silent inflammation. This hormone is derived from the sugars in carbohydrates. Glucagon – A mobilization hormone that tells the body to release stored carbohydrates at a steady rate, leading to stabilized blood sugar levels. This is key for optimal mental and physical performance. This hormone is derived from proteins. Eicosanoids – These are the hormones that ultimately control silent inflammation. They are also master hormones that indirectly orchestrate a vast array of other hormonal

systems in your body (the bio-internet). These hormones are derived from fats (omega 3, 6, 9 and transfats)"

I also highly recommend: Making a Good Brain Great: The Amen Clinic Program by Daniel G. Amen. "This book is wonderful. It gives the reader great understanding and hope that changes in oneself can be made. If you put these changes into action, a happy and healthy brain is yours." (Bill Cosby).Daniel Amen, M.D., one of the world's foremost authorities on the brain, has news for you: your brain is involved in everything you do; learn to care for it properly, and you will be smarter, healthier, and happier in as little as 15 days! You probably run, lift weights, or do yoga to keep your body in great shape; you put on sunscreen and lotions to protect your skin; but chances are you simply ignore your brain and trust it to do its job. People unknowingly endanger or injure their brains, stress them by working at a frenzied pace and not getting enough sleep, pollute them with caffeine, alcohol, and drugs, and deprive them of proper nutrients. Brain dysfunction is the number one reason people fail at school, work, and relationships. The brain is the organ of learning, working, and loving, the supercomputer that runs our lives. It's very simple: when our brains work right, we work right; and when our brains have trouble, we have trouble in our lives. Luckily, it's never too late: the brain is capable of change, and when you care for it, the results are amazing. Making a Good Brain Great gives you the tools you need to optimize your brain power and enrich your health and your life in the process. The principles and exercises in this book, based on years of cutting-edge neuroscience research and the experiences of thousands of people, provide a wealth of practical information to teach you how to achieve the best brain possible."

You should also see and listen to the highly informative book: Spark: The Revolutionary New Science of Exercise and the Brain (Hardcover or audio download) by John J. Ratey (Author), Eric Hagerman (Contributor). Review "This book is a real turning point that explains something I've been trying to figure out for years. Having experienced symptoms of both ADHD and mild depression, I have personally witnessed the powerful effects of exercise, and I've suspected that the health benefits go way beyond just fitness. Exercise is not simply necessary, as Dr. Ratey clearly shows its medicine." (Three-time winner of the Tour de France Greg Le Mond). "SPARK is just what we need-a thoughtful, interesting, scientific treatise on the powerful and positive impact of exercise on the brain. In mental health, exercise is a growth stock and Ratey is our best broker." (Medical Director for the National Alliance on Mental Illness Ken Duckworth, M.D.) "Bravo! This is an extremely important book. What Cooper did decades ago for exercise and the heart, Ratey does in SPARK for exercise and the brain. Everyone--teachers, doctors, managers, policy-makers, individuals trying to lead the best kind of life--can benefit enormously from the utterly convincing and brilliantly documented thesis of this ground-breaking work. People know that exercise helps just about everything, except anorexia, but it will surprise most people just how dramatically it improves all areas of mental functioning. So, get moving! You're brain will thank you and repay you many times over." (The Hallowell Centers Edward Hallowell, M.D.)

"At last a book that explains to me why I feel so much better if I run in the morning! This very readable book describes the science behind the mind-body connection and adds to the evidence that exercise is the best way to stay healthy, alert, and happy!" A groundbreaking and fascinating investigation into the transformative effects of exercise on the brain, from the bestselling author and renowned psychiatrist John J. Ratey, MD. Did you know you can beat stress, lift your mood, fight memory loss, sharpen your intellect, and function better than ever simply by elevating your heart rate and breaking a sweat? The evidence is incontrovertible: Aerobic exercise physically remodels our brains for peak performance. In SPARK, John J. Ratey, M.D., embarks upon a fascinating and entertaining journey through the mind-body connection, presenting startling research to prove that exercise is truly our best defense against everything from depression to ADD to addiction to aggression to menopause to Alzheimer's. Filled with amazing case studies (such as the revolutionary fitness program in Naperville, Illinois, which has put this school district of 19,000 kids first in the world of science test scores), SPARK is the first book to explore comprehensively the connection between exercise and the brain. It will change forever the way you think about your morning run---or, for that matter, simply the way you think." It is important to keep in mind that Radiant Brain Health and a Lean Body Mass ought to be the primary objectives of any exercise system. I experienced this optimal state of health for about 19 straight years via Yoga practices and a vegetarian regimen. But to consistently sustain a healthy life one needs to be self-disciplined and vigilant with nutritionally balanced whole foods (good fats, lean proteins and light carbohydrates) the macronutrients and some micronutrient (vitamins and minerals) like Sun Chlorella, a superfood that I use as my primary source of high quality protein.

Brain health for your body and mind is absolutely necessary to enjoy what Thomas Jefferson calls life, liberty and the pursuit of happiness. That right to be happy is granted not only through social-political means but also through a healthy emotional program. There is a great amount of literature now available about what makes a human being happy, and we will reference some of it throughout this course. Specifically, there is a field called positive psychology. The most popular course at Harvard University is based on this psychology and it is called: Happier: Learn the Secrets to Daily Joy and Lasting Fulfillment by Tal Ben-Shahar. The book is now available online through audible.com.[244] "Can we really learn to be happy? Yes, we can. Each semester, nearly 1,400 students' sign up for Harvard Professor Tal Ben-Shahar's life-changing class "How to Get Happy". Currently it's the hottest course at Harvard, taken by 20 percent of graduates. In Happier, Professor Ben-Shahar brings the ideas of the Ivory Tower to Main Street, distilling the lessons and exercises from his course into an audio trove of practical wisdom. Grounded in the Positive Psychology movement, based on years of researching the works of scientists, academics, and philosophers, Happier emphasizes the importance of pursuing a life of both pleasure and meaning. Lessons, exercises, and "Happiness Boosters" cover self-esteem, empathy, friendship, love, achievement, creativity, spirituality, and humor. Questions will help listeners identify activities that will make them happier immediately, as they apply what they've learned to school, work, and personal relationships. You'll discover that happiness, not money, is the ultimate currency, that we can't be happy unless we first give ourselves permission to be human, and that happiness isn't so elusive after all."

One of the most interesting things about the positive psychology format is that it has given us a new understanding of the evolution of psychology. They state that psychology is a half-baked science because for the last couple of centuries psychology was primarily concerned with what was wrong with human beings, with their deficiencies, their diseases, their mental problems, and of

course, the cures that are possible and how to manage the therapies. But in the last half of the 20th century another question has emerged. What is right with human beings? Through these studies we have learned that the lessons that you derive from sick people are not exactly the same lessons that you derive from healthy, champion performers. There is a different set of lessons that are learned from those who are living at their best. Positive psychology is now illuminating how these optimal performers not only acquire their state of being, but how it actually works. Happiness results when there is coordination between knowledge, talent and skills. That's how I became an MVP, the most valuable player in the diamond field of baseball. You can also become one of the best in your field. You will derive joy and happiness from that kind of performance. You will see yourself in a new light, in a dignified form.

So, without further ado, let's look at how I discovered this optimal performance program. I will illustrate this with an example from my own experience. I discovered the physical strength principle that we are outlining here through my introduction to baseball. At age 9, I was introduced into playing baseball at the YMCA in New York City. The team was called the NY Mets, I played with them for 4 years, this team had a very nice coach, he was like our older brother and we loved him very much. But year after year, we played and were always losers, always in last place. I was placed in right field and played that position year after year. We were just happy to be able to play and have fun. Around the 3rd year, I realized, there was another team in the league that always came in first place, year after year. I didn't really understand it; I only took it for granted that they were better.

During the early part of my 4th year, some of my friends, decided to try out for that season with the winning team called the Pirates or Buccaneers and they made it to the champion team. And now in my 4th year, my friends were playing against my loser team. Suddenly for the first time, my friends became winners too and that shocked the living daylights out of me. It made me think hard about why my friends were now winners and we were still losers, and it forced me to look at the situation and question what was wrong with our team, maybe it wasn't me who was a loser, maybe it was our coach, or maybe it was something else. So at the beginning of my 5th year, I decided to try out for the same champion team that my friends had joined, and I was accepted. The first thing I noticed was that they began training early in the month of January, six months before the baseball season started. The second thing I noticed was that the coach was a National Basketball Association (NBA) professional player who had injured his leg and couldn't play anymore. He decided to coach both, basketball and baseball little league teams, and both of his teams were winners. The training that he gave us was rigorous and professional. He had us run 60 city blocks at the beginning of the workout and had us doing 100 pushups and 100 pull ups etc.

By the time the season started in June, we were the best of the best. It was no wonder this team outperformed all the others. Another important thing he did was when I told him I was a right fielder for four years; he didn't place me where I had been before. He decided to evaluate me as a right fielder, an infielder, a pitcher etc, to see where my strengths were, and he determined that I had the character of a pitcher. He taught me five pitches: a fastball, a slider, a knuckleball, a curve ball, and an underarm pitch. I mastered all five pitches thanks to his instructions, and by the end of the season I had acquired two Most Valuable Player (MVP) trophies. Not only was I the winning pitcher for the borough of Manhattan, having played and won against all the other boroughs (Brooklyn, Queens, Bronx and Staten Island) of New York City, and therefore, received the All Star MVP award for our League, but I also broke a ten year record of the champion team itself. I struck out 127 batters in 15 games. These were 7 inning games so it resulted in an average of two strike outs per inning. This was the best performance ever in the ten year history of the Grosvenor House in Manhattan (1962-1972).

This experience was astonishing for me because of the losing team I had come from. That experience haunted me for decades because I didn't understand how it was possible that a protracted loser all of a sudden became an extraordinary winner. I longed to know what the secret of that extraordinary performance was. Finally in 1999 or 27 years after my championship experience, the clarification of how that happened came to me in a book by the Gallup Group: First Break All the Rules: What the World's Greatest Managers Do Differently by Marcus Buckingham and Curt Coffman.[245] This book is the result of an investigation of over 80,000 managers in Fortune 500 companies during the 90's. The research investigated what differentiates great managers from mediocre managers. The conclusion they came to was that great managers distinguish themselves from mediocre managers by knowing people, the talent that the individual has, the knowledge the individual gets, and the skill the individual acquires. That fundamental distinction between talent, knowledge and skill is absolutely crucial to a great manager because a great manager knows that skills can be acquired through training, knowledge can be acquired through awareness, reading and investigating, but talent is inbred, it's innate, it is a recurrent optimal performance of a certain type of task. Talent is the ease with which you can perform a task that comes naturally to you, and that comes from how you were wired up as you grew up. When we are young, we have many more brain cells, than normal adults. The brain inflates during the first years of life, and then it prunes, it contracts, and it sheds, about half of the brain cells it started with. In the pruning process, the brain shrivels up and breaks off some of those synaptic connections and what is left is the fundamental character of the personality that the person will have for the rest of his life.

Intuitively, the great manager knows how to detect the character of the individual and what strengths he carries with him. What they do is first identify the talent or strength the person has and then places that strength in an area that will fructify. They place the individual in an area of work that will facilitate the actualization of that capability. This is what great managers excel at. Their ability to acknowledge the individual, see where their talents reside, and then place them in an area of work that will allow for that strength to actualize. Not only will the person be happier when they are acting at their best, they are also in harmony with what's best in them. This harmonizing role enables the person to fulfill his highest performance capability. So once I understood how my manager discovered my strength, I then asked a second question. I don't have a manager now, how do I evaluate my own strengths? The question was answered by a sequel that the Gallup Group published in the year 2000. Now that you know what Great Managers Do Differently, let's try to identify what your particular strengths are so that you can do as they do.

The Gallop book: Now Discover Your Strengths by Marcus Buckingham and Donald O. Clifton,[246] has become a bestseller

because not only do they include the knowledge base that they acquired through the previous research with great managers but they were now able to codify with 34 key characteristic terms, in a language that will help you identify where you strengths are via an internet test called the strengthfinder exam. This program was developed through a research of 2 million cases, asking crucial questions of where people's performances were, then they designed an exam that identifies those particular characteristics of where their talent resides. As you will see, these 34 characteristics cover a wide spectrum of experience. There are multiple applications of the test, for kids, for business, for social life etc. The particular application of the strengthfinder that we want as college students is called strengthquest, which is a book online and in print that you can download and subscribe to @ https://www.strengthsquest.com/content/?ci=23407 . This particular form of The Strengthfinder exam is adequate to help you become a self-educator.

This exam is not an aptitude exam, it is more an identifier of where your talent resides in your character. An aptitude test is an identifier of your skills and knowledge. A strengthfinder exam identifies the characteristics of your talents. It's a deeper cognitive test that helps you identify your character. The results I got when I took the test were absolutely exceptional. They have a base of 34 character names, such as connectedness, learner, imputer, futurist, strategic thinker, woo, activator, etc. These are just some of the key terms, when you take the test, five of these characteristics will emerge. It is a 20 minute exam. The results for my first test were connectedness, strategic, imputer, learner, and futurist. To me it was surprising to see the accuracy of these results. For example, strategic—a military term applied to how successful you are at surprising your opponent—is the key characteristic of an MVP pitcher because he is in the business of constantly trying to surprise his opponent, the batter. It is very interesting that today the field I am training for is 3 football stadiums size (The National Ignition Facility) and what I am focused on delivering is a laser beam that hits its target with "accuracy comparable to throwing a pitch over the strike zone from 350 miles away." Try visualizing a laser pitch that travels approximately from New York to Pittsburgh (See figure 86 in section 2.4 below). An excellent book entitled; Strategic Intuition: The Creative Spark in Human Achievement (Columbia Business School) (Hardcover and Audio download) by William Duggan has placed this talent into a powerful multi-disciplinary context.

Amazon.com Review."The best strategy book of the year." -- David Newkirk, Strategy+Business "A concise and entertaining treatise on human achievement." -- William Easterly, Wall Street Journal "This book might just change how you look at human thought and strategy, and influence how you organize yourself and your team strategically." -- Jack Covert, 800-CEO-Read. This book will be the first to introduce formally, authoritatively, and convincingly the notion of strategic intuition to the business and finance communities. All strategic leaders can benefit immensely from it. -- Douglas C. Lovelace, Senior National Security Strategist. Whether finding the next great game designer or the next great entrepreneur, I always try to find those special few who have made the 'giant leap' to the next big idea. William Duggan finally explains how the mind forms great leaps and how throughout time individuals have used strategic intuition to change the world. Strategic Intuition should be required reading for anyone in the venture capital business. -- Gilman Louie, partner, Alsop Louie Partners and former CEO of In-Q-Tel
Whether the subject is art, science, or business, William Duggan takes us on a fascinating exploration into how the human brain connects experience and knowledge to create entirely new ideas in momentary flashes of insight. A definitely important read for anyone charged with bringing innovation to strategic leadership. -- Robin Harper, vice president, marketing and community development, Linden Lab, creator of Second Life. William Duggan's book is really on point. His work has enormous implications for the teaching of strategy. -- Glenn Hubbard, Dean, Columbia Business School. "The best strategy book of the year." -- David Newkirk, Strategy+Business."A concise and entertaining treatise on human achievement." -- William Easterly, Wall Street Journal. "This book might just change how you look at human thought and strategy, and influence how you organize yourself and your team strategically." -- Jack Covert, 800-CEO-Read.

Imputer is a person who continuously gathers information, constantly reads, researches, and accesses information. Well, for over 30 years that has been my lifestyle, I read 5 to 10 books a month, scientific journals, listen to radio talk shows, I am a bibliographic researcher, scientific translator, etc., but I never identified myself as an imputer until I took this exam. The learner applied to me because l have always been fascinated with the process of learning, but learning for leaning's sake, for a very long time I was never really concerned about getting a degree. The enjoyment of the learning process has been the prime motivator throughout my life. Of course, learning for learning's sake, is a great thing, but it's insufficient for optimal success in life because we do need to have goals and achievements that will make that knowledge not only personally enjoyable, but also socially acceptable, certifiable and serviceable to perform a healthy, positive function in society. That's why I now believe that degrees and the recognition of achievements are very important. Then there was the futurist characteristics, this was particularly insightful, because during my freshman year in college, I was already designing my PhD program. I decided that I wanted to be a teacher so I was looking at Graduate Catalogs from Columbia University's Teachers College, and see what the requirements to become a doctor of education were. I used to laugh at myself because I thought it was very pretentious of me to be thinking about this as a freshman in a community college, but it was always characteristic of me because I was always thinking of what was lying ahead and inquisitive about what was the future like. I was enthralled by Arthur C. Clark's vision, of the world of satellites and the future of global communication back in the 70's. I always had this hopeful and futuristic vision that inspired my laser outlook in life. I discovered the coherent sense of connectedness in modern science and technology via the wave structure of the laser. This is truly the character that motivated the entire Laser Information Age book project.

Then in a second test the activator emerged. An activator begins new programs; he is a spearhead or pioneer. Presidents of new societies have this character. I remember when I was in Venezuela (1982), while working as a teacher of English as a Second Language (ESL instructor) and science book translator, I was nominated to be president of a CosmoBiology Society, because I was motivating scientists and engineers in the school to study the relationship between the cosmos and biology. We developed a documentation forum with seminars, workshops and teaching engagements related to the science. Now I am advocating for the formation of a group of optical philosophers, scientist, engineers and policy thinkers who are focused on realizing the Open Resource Based Economy.

Woo (winning others over) character also emerged; this has to do with communicating your ideas and feelings enthusiastically and effectively to others. To this day I know that this is the case. The important thing to realize is that reflection and self-examination through the strengthfinder turns out to be a useful and reliable tool to focus your career goals and to organize an education curriculum accordingly. For example, going to college is no longer about fitting in or adapting yourself to what is out there, it's more about customizing the knowledge base of courses to your particular character. It's not about preparing for a job function in society; it's about actualizing who you are or where your best capabilities are, signifying that you have to identify where that potential is and what courses coordinate with that particular potential.

The quest for your particular identity within a state capitalist society of organizations is very difficult because the monetary value that is underwriting the hierarchical structure of the corporation undermines and overrides the individual value of most people. The corporate pyramid structure is designed to sacrifice the well-being of the many at the bottom for a privileged few at the top; it is basically a master-slave system. It takes a very courageous and talented manager to overcome that huge obstacle and break the rules (the policies) in order to work for the benefit of the individual and the organization in a democratic way. For an insightful discussion of how your particular identity emerges within a society of organizations see 'Beyond the Hype, Rediscovering The Essence of Management by Robert G. Eccles and Nitin Nohria with James D. Berkley. Part 1. Building an Action Perspective. Chapter 4. The Quest for the Particular. The following Amazon review of this book is very accurate.

Shunning the latest concepts, the authors argue, managers do today what they have always done: mobilize action. Great leadership is achieved by targeting appropriate actions, communicating it using simple and inspiring rhetoric and then getting it done. "Silver bullets," they argue, do not exist. Despite the proclamations of publicity-conscious consultants and revenue-hungry book publishers, the essence of management remains what it has always been:

1. Using and Understanding Rhetoric

2. Taking Action

3. Recognizing Individual Identities.

The book's first section posits that management relies on a classical definition of rhetoric. Managers live in a universe where language is used not only to communicate but also to persuade and to create. It acts as a powerful force that is always at work in an organization. Almost every situation a manager faces during the course of his or her day has something to do with rhetoric: one-on-one conversations, team meetings, presentations to large and small audiences, memos, articles, project proposals, appropriate requests, strategic plans, vision statements. In each, managers wrestle with language in their quest to find solutions and the correct courses of action. Second, despite the "flavor of the month" phenomenon common in our organizations, every decision revolves around meeting short-term objectives while retaining long-term flexibility. Finally, managers depend on their people. Their ability to recognize unique talents and abilities plays a direct role in the success of their plans and ventures. This is a book of uncommon wisdom. In my mind it is a sin that it has been allowed to go out of print. Good management comes from targeting correct action and communicating it to the proper people. The formula does not change. It is a message that any serious manager should read and cement into the cornerstone of his or her managerial style. [247]

What great managers do is that once they identify what the talent is, they coordinate that with knowledge and skillful action. They give you knowledge which is awareness of how things are done or best practices and the science of how that particular function works. If you are an optical or laser engineer you learn all the science and related skills set for that kind engineering. The effective coordination of your talent, knowledge and skills will propel you to the best performer as engineer. If you are an artist, architect, mathematician, philosopher, an economist, a social or political scientist, a doctor, or a lawyer etc, it works the same way. However, to accomplish this triumphant coordination and bridge the gap between knowledge and action or the knowing-doing gap you will need not only self-knowledge but self-discipline and right action. This crucial aspect of the Laser Informed Learner's Strengthquest program is called self, time and project management. The healthy development of any professional knowledge worker is dependent on the mastery of all three of these disciplines.

Here we start this triple course with Peter Drucker's ideas on self management in Wikipedia: Peter Ferdinand Drucker (November 19, 1909–November 11, 2005) was a writer, management consultant, and self-described "social ecologist."[1] Widely considered to be the father of "modern management," his 39 books and countless scholarly and popular articles explored how humans are organized across all sectors of society—in business, government and the nonprofit world.[2] His writings have predicted many of the major developments of the late twentieth century, including privatization and decentralization; the rise of Japan to economic world power; the decisive importance of marketing; and the emergence of the information society with its necessity of lifelong learning.[3] In 1959, Drucker coined the term "knowledge worker" and later in his life considered knowledge work productivity to be the next frontier of management.[4] Peter Drucker was a writer, teacher, and consultant. His thirty-four books have been published in more than seventy languages. He founded the Peter F. Drucker Foundation for Nonprofit Management, and counseled thirteen governments, public services institutions, and major corporations."

The first of Drucker's books I recommend for the triple management of self, time and your education project is: Management (Revised Edition) by Peter F. Drucker. Revised and Updated By Joseph A. Maciariello. Forward by Jim Collins. On the front matter of the book we find this wonderful first person statement.

"Peter F. Drucker was asked in early 1999, "What do you consider to be your most important contribution? His answer:

That I early on—almost sixty years ago—realized that management has become the constitutive organ and function of the Society of Organizations;

That management is not "Business Management"—though it first attained attention in business—but the governing organ of all institutions of Modern Society;

That I established the study of management as a discipline in its own right; and

That I focused this discipline on People and Power; on Values, Structure and Constitution; and above all on responsibilities—that is, focused the Discipline of Management on management as a truly liberal art. Peter F. Drucker, January 18, 1999[248]

I awoke one morning with Drucker's audiobook discussion on: The Accountable School; from Chapter 14 of this seminal, essential and foundational text on management. I found his vision and judgment to be one of the most brilliant and genuine expose of the current issues with education, I have ever heard. First of all he covers the full spectrum knowledge of the issues, illuminating the Japanese and the European success story in relation to the demise of the US public system that he blames on the slave legacy and the transformation of the school from being a learning agent to a socialization agent. Peter clearly shows in this book how relevant all the management principles are to education. He gives specifications on the mission, task, responsibility and social position of the school in the post capital or knowledge society. Universal literacy of a high order is a primary requirement for all students young and old. Students on all levels have to learn how to learn in general and how they personally learn in particular. They have to learn to be life-long learners, with the motivation and discipline to learn continuously. He acknowledges how the information technology revolution (Laser Information Age) will transform the way we learn and teach. The institution of education will be repositioned from being "of society…to being "in society." Its mission is no longer exclusively for the young but also for the adult. The school in the knowledge society is integrated with and a partner to all the institutions of society (government, industry, nonprofits, the family etc). It has to be an Open System (OER or OCW) accessible to everybody everywhere and no longer a monopoly. A more natural socialization of the student will result from the open system. And finally the school has to be accountable for performance and results. It has to impart knowledge as substance (subject matter) and as process (methods of how we learn and perform). The focus has to be on identifying and building the students strengths and making his weaknesses irrelevant.

Drucker's seminal concept of The Universally Educated Person in Chapter 48 of Management is foundational. "Knowledge is not impersonal, like money. Knowledge does not reside in a book, a databank, a software program; they contain only information. Knowledge is always embodied in a person; carried by a person; created, augmented, or improved by a person; applied by a person; taught and passed on by a person; used or misused by a person. The shift to the knowledge society therefore puts the person in the center. In so doing, it raises new challenges, new issues, new and quite unprecedented questions about the knowledge society's representative, the educated person. In the knowledge society, the educated person is society's emblem; society's symbol; society's standard bearer. The educated person is the social "archetype"—to use the sociologist's term. He or she defines society's performance capacity. But he or she also embodies society's values, beliefs and commitments. This must change the very meaning of "educated person." It will thus predictably make the definition of an "educated person" a crucial issue. The educated person now matters. The knowledge society must have at its core the concept of the educated person.

It will have to be a universal concept, precisely because the knowledge society is a society of knowledges and because it is global—in its money, its economics, its careers, its technology, its central issues, and above all, in its information. Post-capitalist society requires a unifying force. It requires a leadership group, which can focus local, particular, separate traditions onto a common and shared commitment to values, a common concept of excellence, and on mutual respect. Post-capitalist society is both, a knowledge society and a society of organizations, each dependent on the other and yet each very different in its concepts, views, and values. Elements of the educated person and access to the great heritage of the past will have to be an essential element. The educated person will have to be able to appreciate other cultures and traditions: for example, the great heritage of Chinese, Japanese, and Korean paintings and ceramics; the philosophers and religions of the Orient; and Islam, both as a religion and as a culture. far less exclusively "bookish" than the product of the liberal education of the humanists will need to be trained in perception (see Edward de Bono) fully as much as analysis.

The Western tradition will, however, still have to be at the core, if only to enable the educated person to come to grips with the present, let alone the future. The future may be "post-Western"; it may be "anti-Western." It cannot be "non-Western." Its material civilization and its knowledges all rest on Western foundations: Western science; tools and technology; production; economics; Western-style finance and banking. None of these can work unless grounded in an understanding and acceptance of Western ideas and of the entire Western tradition. prepared for life in a global world It will be a "Westernized" world, but also increasingly a tribalized world, must become a "citizen of the world"—in vision, horizon, information will also have to draw nourishment from their local roots and, in turn, enrich and nourish their own local culture be prepared to live and work simultaneously in two cultures—that of the "intellectual," who focuses on words and ideas, and that of the "manager," who focuses on people and work. Intellectuals see the organization as a tool; it enables them to practice their techné, their specialized knowledge (defined as a "useful knowledge" in his Innovation and Entrepreneruship).

Managers see knowledge as a means to the end of organizational performances. Both are right, they are opposites; but they relate to each other as poles rather than as contradictions. They surely need each other: the research scientist needs the research manager just as much as the research manager needs the research scientist. If one overbalances the other, there is only nonperformance and all-around frustration. The intellectual's world, unless counterbalanced by the manager, becomes one in which everybody "does his own thing" but nobody achieves anything. The manager's world, unless counterbalanced by the intellectual, becomes the stultifying

bureaucracy of the "organization man." But if the two balance each other, there can be creativity and order, fulfillment and mission. A good many people in the post-capitalist society will actually live and work in these two cultures at the same time. And many more should be exposed to working experience in both cultures, by rotation early in their careers—from a specialist's job to a managerial one, for instance, rotating the young computer technician into project manager and team leader, or by asking the young college professor to work part-time for two years in university administration. And again, working as "unpaid staff" in an agency of the social sector (see Managing the Non-Profit Organization and Citizenship through the Social Sector in The Essential Drucker) give the individual the perspective and the balance to respect both worlds, that of the intellectual and that of the manager. All educated persons in the post-capitalist society will have to be prepared to understand both cultures (see The Essential Drucker for an introduction to management).

The technés have to become part of what it means to be an educated person. See heading: Technés and the Educated Person. But their job or their profession was seen as a "living," not a "life." But now that the technés have become knowledges in the plural, they have to be integrated into knowledge. The fact that the liberal arts curriculum they enjoyed so much in their college years refuses to attempt this is the reason why today's students repudiate it a few years later. They feel let down, even betrayed. They have good reason to feel that way. Liberal arts and Ailgemeine Bildung that do not integrate the knowledges into a "universe of knowledge" are neither "liberal" nor "Bildung." "They fall down on their first task: to create mutual understanding, that "universe of discourse" without which there can be no civilization. Instead of uniting, such disciplines only fragment.

But all over the world today's students, a few years after they have graduated, complain that "what I have learned so eagerly has no meaning; it has no relevance to anything I am interested in or want to become." They still want a liberal arts curriculum for their own children—Princeton or Carleton; Oxbridge; Tokyo University; the lycée; the Gymnasium-though mainly for social status and access to good jobs. But in their own lives they repudiate such values. They repudiate the educated person of the humanists. Their liberal education, in other words, does not enable them to understand reality, let alone to master it. We neither need nor will get "polymaths," who are at home in many knowledges; in fact, we will probably become even more specialized. But what we do need—and what will define the educated person in the knowledge society—is the ability to understand the various knowledges. What is each one about? What is it trying to do? What are its central concerns and theories? What major new insights has it produced? What are its important areas of ignorance, its problems, its challenges? Without such understanding, the knowledges themselves will become sterile; will indeed cease to be "knowledges." They will become intellectually arrogant and unproductive. For the major new insights in every one of the specialized knowledges arise out of another, separate specialty, out of another one of the knowledges. The specialists have to take responsibility for making both themselves and their specialty understood. The media, whether magazines, movies, or television, have a crucial role to play. But they cannot do the job by themselves. Nor can any other kind of popularization. Specialties must be understood for what they are: serious, rigorous, demanding disciplines. This requires that the leaders in each of the knowledges, beginning with the leading scholars in each field, must take on the hard work of defining what it is they do. There is no "queen of the knowledges" in the knowledge society. All knowledges are equally valuable; all knowledges, in the words of the great medieval philosopher Saint Bonaventura, lead equally to the truth. But to make them paths to truth, paths to knowledge, has to be the responsibility of the men and women who own these knowledges. Collectively, they hold knowledge in trust.

Capitalism had been dominant for over a century when Karl Marx in the first volume of Das Kapital identified it (in 1867) as a distinct social order. The term "capitalism" was not coined until thirty years later, well after Marx's death. It would, therefore, not only be presumptuous in the extreme to attempt to write The Knowledge today; it would be ludicrously premature. All that can be attempted is to describe society and polity as we begin the transition from the Age of Capitalism (also, of course, from the Age of Socialism… One thing we can predict: the greatest change will be the change in knowledge—in its form and content; in its meaning; in its responsibility; and in what it means to be an educated person."

In a Wikiquote Drucker stated that; "Universities won't survive. The future is outside the traditional campus, outside the traditional classroom. Distance learning is coming on fast." I got my degree through E-mail, Forbes (June 16, 1997).Thirty years from now the big university campuses will be relics. Universities won't survive. It's as large a change as when we first got the printed book. Do you realize that the cost of higher education has risen as fast as the cost of health care? And for the middle-class family, college education for their children is as much of a necessity as is medical care—without it the kids have no future. Such totally uncontrollable expenditures, without any visible improvement in either the content or the quality of education, means that the system is rapidly becoming untenable. Higher education is in deep crisis." Seeing things as they really are, Forbes (March 10, 1997)... All earlier pluralist societies destroyed themselves because no one took care of the common good. They abounded in communities but could not sustain community, let alone create it. -- The New Pluralism Leader to Leader, No. 14 (Fall 1999)... Human beings need community. If there are no communities available for constructive ends, there will be destructive, murderous communities... Only the social sector, that is, the nongovernmental, nonprofit organization, can create what we now need, communities for citizens... What the dawning 21st century needs above all is equally explosive growth of the nonprofit social sector in building communities in the newly dominant social environment, the city. Civilizing the City, Leader to Leader, No. 7 (Winter 1998)

The second book I recommend for practice is: Managing Oneself by Peter Ferdinand Drucker. Amazon.com Review: We live in an age of unprecedented opportunity: with ambition, drive, and talent, you can rise to the top of your chosen profession regardless of where you started out. But with opportunity comes responsibility. Companies today aren't managing their knowledge workers' careers. Instead, you must be your own chief executive officer. That means it's up to you to carve out your place in the world and know when to change course. And it's up to you to keep yourself engaged and productive during a career that may span some 50 years. In Managing Oneself, Peter Drucker explains how to do it. The keys: Cultivate a deep understanding of yourself by identifying your most valuable strengths and most dangerous weaknesses. Articulate how you learn and work with others and what your most deeply held values are. Describe the type of work environment where you can make the greatest contribution. Only when you operate

with a combination of your strengths and self-knowledge can you achieve true and lasting excellence. Managing Oneself identifies the probing questions you need to ask to gain the insights essential for taking charge of your career.[249]

Peter F. Drucker, born in 1918, is probably the 20st Century's greatest management thinker. He was Professor at New York University and taught at the Graduate Management School of Claremont University, California. Drucker is the authors of numerous books and award-winning articles. This article was published in the March-April 1999 issue of the Harvard Business Review. Today, knowledge workers outlive organizations and are mobile. The need to manage oneself is therefore creating a revolution in human affairs. Drucker gives advice on the management of ourselves. We need to ask ourselves the following questions: What are my strengths? How do I perform? What are my values? The author provides advice on how to answer these questions> Once these questions are answered we need to find out where we belong and what we should contribute. According to Drucker, "we will have to place ourselves where we can make the greatest contribution." But because we need to work with others we also need to take responsibility for our relationships. This requires us to accept other people as much as individuals as ourselves and take responsibility for communication. The author also identifies that most knowledge workers are not "finished" after 40 years on the job, "they are merely bored". He identifies three ways to develop a second career: (1) start one; (2) develop a parallel career; or (3) be a social entrepreneur. And managing the second half of your life requires you to begin with it before you enter it. A Great article by the Master of Management on how we can manage ourselves. He recognizes the latest trend whereby knowledge workers are outliving organizations which result in them having/creating second careers. He provides advice on where to locate yourself based on your strengths, performance, and values. This article is an excerpt from his 1999-book 'Management Challenges for the 21st Century'. As usual Drucker uses his famous simple US-English writing style. Highly recommended, just like all his articles."

One of my most important findings in Managing Oneself was the command to "discover where your intellectual arrogance is causing disabling ignorance and overcome it." I found that my love for ideas made me contemptuous of knowledge about people as if ideas are more important than people. This was the same flaw I found in state capitalists, who value money more than people. Taking pride in such a disabling ignorance leads one and perhaps an entire society not only to disastrous relationships but to the creation of an awful character. The search for practical guidance on this particular issue led me to an examination of the first sentence in: The Daily Drucker: 366 Days of Insight and Motivation for Getting the Right Things Done by Peter F. Drucker. "The proof of the sincerity and seriousness of a management is uncompromising emphasis on integrity of character." I was struck by this emphasis on the integrity of the moral character in a leader as the foundation of management without which one cannot lead knowledge workers or be respected by others. This reflection stimulated a quest for what is the character of a person in general and my particular character in particular. This quest led to a few important questions for example; what kind of character am I? A practical and reliable way to approach this fundamental question as you have seen above is the Strengthfinder exam. Our character only performs via strengths, so the more we cultivate those characteristics the more integrity our character will exhibit. Weaknesses are non-performance areas of our character, so when we operate from weakness we show inconsistency in our character. Another important question that emerged was; how much integrity does my character actually have? Again, I found that consistency with the strengthfinder results is the key. A clear image of integrity in my character emerged from the characterizations of the strengthfinder. According to Drucker, character is a quality of being as distinct from knowing (awareness) as it is from doing (skill). A further Wikipedian search for character led me to a wonderful multidimensional article on the anthropology of the human being. How interesting that to fill the gap between knowing and doing, one needs to be honest with oneself and to assert the integrity of being. This led me to the understanding that it is the actualization of your authentic being or strengths that fills the gap between knowledge and action.

For time management we can start with Peter Drucker's: The Effective Executive in Action: A Journal for Getting the Right Things Done (Journal) by Peter F. Drucker and Joseph A. Maciariello. Editorial Reviews From Amazon.com "The Effective Executive (1966) forms one of the foundations of Drucker's reputation as a management leadership guru, and this workbook companion developed by Maciariello, a professor at Drucker's business management school, draws heavily upon the master source. The format extracts bullet points from the original text, along with supplementary material from other Drucker writings, then adds reinforcing questions and suggested action items. Additional space is provided to write down reflections and results. "Decision making is the specific activity of the executive," Drucker writes, but before you can learn how to make the right decisions, you need to manage your work time and concentrate your focus on the right tasks, then develop your strengths and the strengths of those around you. These precepts have become familiar mantras in the management environment, so little of the material should come as a surprise, making the exercises accessible and easy to perform. Key points are emphasized and re-emphasized, developed in broad themes then presented once more for individual review. If the text is repetitive, it can perhaps be forgiven by the authors' obvious desire to drill Drucker's recommended behavior into readers' heads so that it becomes consistent practice."[250] The Effective Executive in Action is a journal based on Peter F. Drucker's classic and preeminent work on management and effectiveness -- The Effective Executive. Here Drucker and Maciariello provide executives, managers, and knowledge workers with a guide to effective action -- the central theme of Drucker's work. The authors take more than one hundred readings from Drucker's classic work, update them, and provide provocative questions to ponder and actions to take in order to improve your own work. Also included in this journal is a space for you to record your thoughts for later review and reflection. The Effective Executive in Action will teach you how to be a better leader and how to lead according to the five main pillars of Drucker's leadership philosophy.

The Journal is actually based on the companion book: The Effective Executive: The Definitive Guide to Getting the Right Things Done by Peter F. Drucker. Amazon.com Review. "The Effective Executive" (1966) was the first book to define who an executive is and to explain the practices of effective executives. Today there are several in this genre. But this book was the first, as is the case with many of Drucker's masterpieces. Drucker starts the book by stating that this book is about managing oneself and that executives who do not manage themselves cannot possibly expect to manage other people. Efficiency vs. Effectiveness: "Efficiency is doing things right; effectiveness is doing the right things." For manual work, efficiency was enough. In today world, the center of gravity has shifted from the manual worker to the "knowledge worker" (a term Drucker coined in the 60s). For knowledge work, effectiveness

is more important than efficiency. Who is an executive? Executive = a knowledge worker who is ... responsible for contributions (decisions, actions) ... that have significant impact on ... performance and results of the whole organization (derived from pages 5 through 9).

Effective executives:

1. Manage time

2. Focus on contributions and results

3. Build on strengths

4. Set the right priorities

5. Make effective decisions

1. **Manage time**: "Time is the scarcest resource, and unless it is managed, nothing else can be managed" (page 51). Chapter 2, Know Thy Time, starts with a three-step process - recording, managing and consolidating time. Drucker then states the factors that make time a unique resource - the supply of time is inelastic, time is perishable and cannot be stored, time is irreplaceable (i.e. has no substitute), all work takes place in and uses up time. Drucker then explains time-diagnosis with questions for the executive:

a. What would happen if this were not done at all?

b. Which activities could be done by somebody else just as well, if not better?

c. (ask others) What do I do that wastes your time without contributing to your effectiveness? Drucker then explains the identification of time wasters caused by - lack of system, overstaffing, bad organization structure, malfunction in information. If you have spent time in meetings, you will surely be able to relate these concepts to your work. This chapter changed my perception of time as a resource.

2. **Focus on contributions and results**:

In chapter 3, What Can I Contribute?, Drucker stresses the importance of focusing outward, on contributions and results; as opposed to downward, on efforts. He proceeds to discussing the four basic requirements of effective human relations:

a. Communication

b. Teamwork

c. Self-development

d. Development of others

3. **Build on strengths**: "In every area of effectiveness within an organization, one feeds the opportunities and starves the problems" (page 98). In chapter 4, Making Strengths Productive, Drucker explains that effective executives build on strengths and make weaknesses irrelevant. Decades after this book was written, researchers from Gallup arrived at the same result, published in the bestseller "First Break All the Rules"; confirming that Drucker was right all along.

Drucker proceeds to outline four rules for staffing from strength:

a. Make sure the job is well designed

b. Make the job challenging to bring out strengths

c. Have an appraisal policy to measure performance

d. Put up with weaknesses - the exception is a weakness in character and integrity, which causes disqualification.

4. **Set the right priorities**: Chapter 4, First Things First, deals with concentration. Drucker explains that effective executives set the right priorities and stick to them. They concentrate on the areas where superior performance will produce outstanding results. They also set posteriorities - tasks not to tackle. In the section "sloughing off yesterday", Drucker states that effective executives ask "If we did not already do this, would we go into it now?" If the answer is no, the activity is dropped or curtailed. This concept is explained in more detail in Drucker's book titled "Managing For Results" (1964) as purposeful abandonment in chapter 9. America's best known CEO, GE's Jack Welsh, followed this practice when he got rid of GE businesses that could not be number one or two in their industries.

5. Make effective decisions: "No decision has been made unless carrying it out in specific steps has become someone's work assignment and responsibility. Until then, there are only good intensions" (page 136). In chapter 6, The Elements of Decision Making, Drucker explains his five step decision process:

a. Determine whether the problem is generic or unique

b. Specify the objectives of the decision and the conditions it needs to satisfy

c. Determine the right solution that will satisfy the specifications and conditions

d. Convert the decision into action

e. Build a feedback process to compare results with expectations

In chapter 7, Effective Decisions, Drucker states that a decision is a judgment, a choice between alternatives. He explains the importance of creating disagreement, rather than consensus. Drucker explains that disagreement provides alternatives and stimulates imagination. "The first rule in decision making is that one does not make a decision unless there is disagreement" (page 148). In the conclusion, Drucker states that effectiveness can and must be learned and that executive effectiveness is the best hope to make modern society productive economically and viable socially.

If you are an executive, you must read this book."

Once you have identified your strengths with Strengthsfinder and applied them self-reflectively to Drucker's Effective Executive Action program, you are now ready to focus on a rigorous project management system. We go with Wikipedia: Time management refers to a range of skills, tools, and techniques utilized to accomplish specific tasks, projects and goals. This set encompasses a wide scope of activities, and these include planning, setting goals, delegation, analysis of time spent, monitoring, organizing, scheduling, and prioritizing. Initially time management referred to just business or work activities, but eventually the term broadened to include personal activities also. Time management in a broad sense involves both planning and execution. Money can be earned back, however the time once gone is gone. That is what makes time management a really important activity. There is however no agreed and definite way of time management. It depends on the individual person, as how they manage their schedule, and prioritize their activities

A time management system is a designed combination of processes, tools and techniques. As Part of Project Management, Time Management is one of nine core functions identified in the project management body of knowledge (PMBOK), produced by the Project Management Institute. The "Guide to the PMBOK" defines project management as entailing management of scope, cost, time, quality, human resources, risk, communication and procurement. Time Management, as a project management subset, is more commonly known as project planning and/or project scheduling. The PMBOK Guide is process-based, meaning it describes work as being accomplished by processes. This approach is consistent with other management standards such as ISO 9000 and the Software Engineering Institute's CMMI. Processes overlap and interact throughout a project or its various phases. Processes are described in terms of:

- Inputs (documents, plans, designs, etc.)
- Tools and Techniques (mechanisms applied to inputs)
- Outputs (documents, products, etc.)

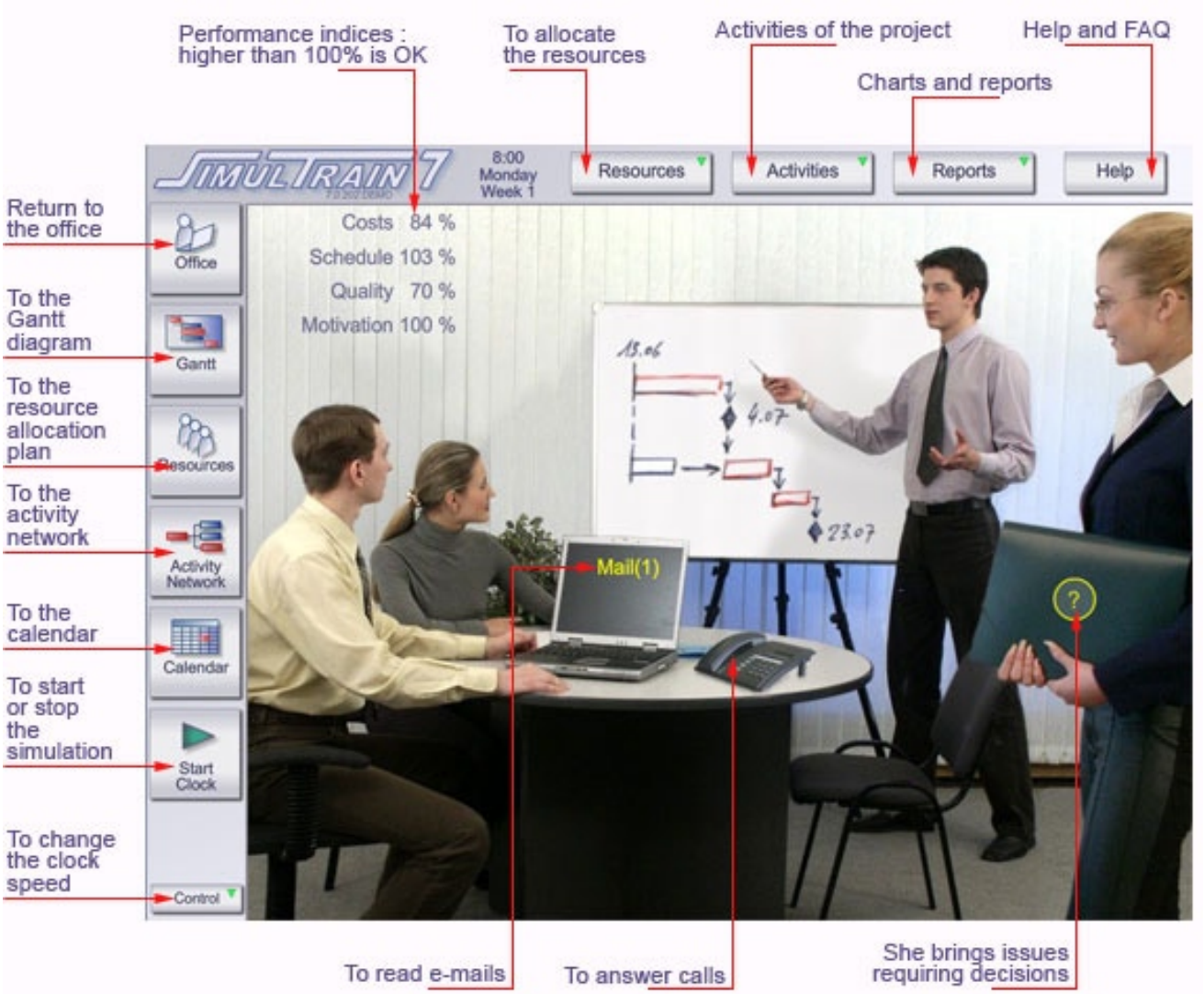

Figure 50. SimulTrain is a Project Management Simulator used in project management training programs. SimulTrain is a simulation of the planning and execution phases of a medium-sized project that involves all of the events that occur. SimulTrain is a computer-based multimedia tool which allows the participants to learn:

- to structure a project;
- to control the progress of a project;
- to use project management tools.

The Guide recognizes 44 processes that fall into five basic process groups and nine knowledge areas that are typical of almost all projects.

- The five process groups are: Initiating, Planning, Executing, Controlling and Monitoring, and Closing.
- The nine knowledge areas are: Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communications Management, Project Risk Management, and Project Procurement Management.

Each of the nine knowledge areas contains the processes that need to be accomplished within its discipline in order to achieve an effective project management program. Each of these processes also falls into one of the five basic process groups, creating a matrix structure such that every process can be related to one knowledge area and one process group. The PMBOK Guide is meant to offer a general guide to manage most projects most of the time. A specialized standard was developed as an extension to the PMBOK Guide to suit special industries for example the Construction Extension to the PMBOK Guide and the Government Extension to the PMBOK Guide. We now look at how the PMBOK is applied by the Software Engineering Institute at Carnegie Mellon University

Figure 51. Software Engineering Institute in Pittsburgh, Pennsylvania. Credit courtesy of Wikipedia.

Since 1984, the SEI has served as a global resource in software engineering, networked systems survivability, and process improvement. The SEI provides technical leadership to advance the practice of software engineering so that software-intensive systems can be acquired and sustained with predictable and improved cost, schedule, and quality. In recent years, software has continued to grow in importance and impact, not only in defense systems, but also in transportation, finance, medicine, entertainment, and all other aspects of everyday life. The SEI has contributed to this growth in many areas including software process improvement, network security and survivability, software architecture and software product lines, interoperability of systems, and the improvement of software acquisition skills. The SEI program of work is conducted in three principal areas: management practices, engineering practices, and acquisition practices. Within these broad areas of work, the SEI defines specific initiatives aimed at solving problems that impede the ability of organizations to acquire, build, and evolve software-intensive systems predictably, on time, within expected cost, with expected functions, and without vulnerabilities.

SEI developed; The Capability Maturity Model (CMM) which was originally applied as a tool for objectively assessing the ability of government contractors' processes to perform a contracted software project. Though it comes from the area of software development, it is also being applied as a generally applicable model to assist in understanding the process capability maturity of organizations in diverse areas; for example in software engineering, system engineering, project management, software maintenance, risk management, system acquisition, information technology (IT), personnel management. It has been used extensively for avionics software and government projects around the world…The Capability Maturity Model has been superseded by a variant, the Capability Maturity Model Integration (CMMI). The old Capability Maturity Model was renamed to Software Engineering Capability Maturity Model (SE-CMM) and organizations' accreditations based on SE-CMM expired on 31 December 2007. Variants of maturity models derived from the Capability Maturity Model have emerged over the years, including, for example, Systems Security Engineering CMM SSE-CMM and the People Capability Maturity Model. Maturity models have been internationally standardized as part of ISO 15504.

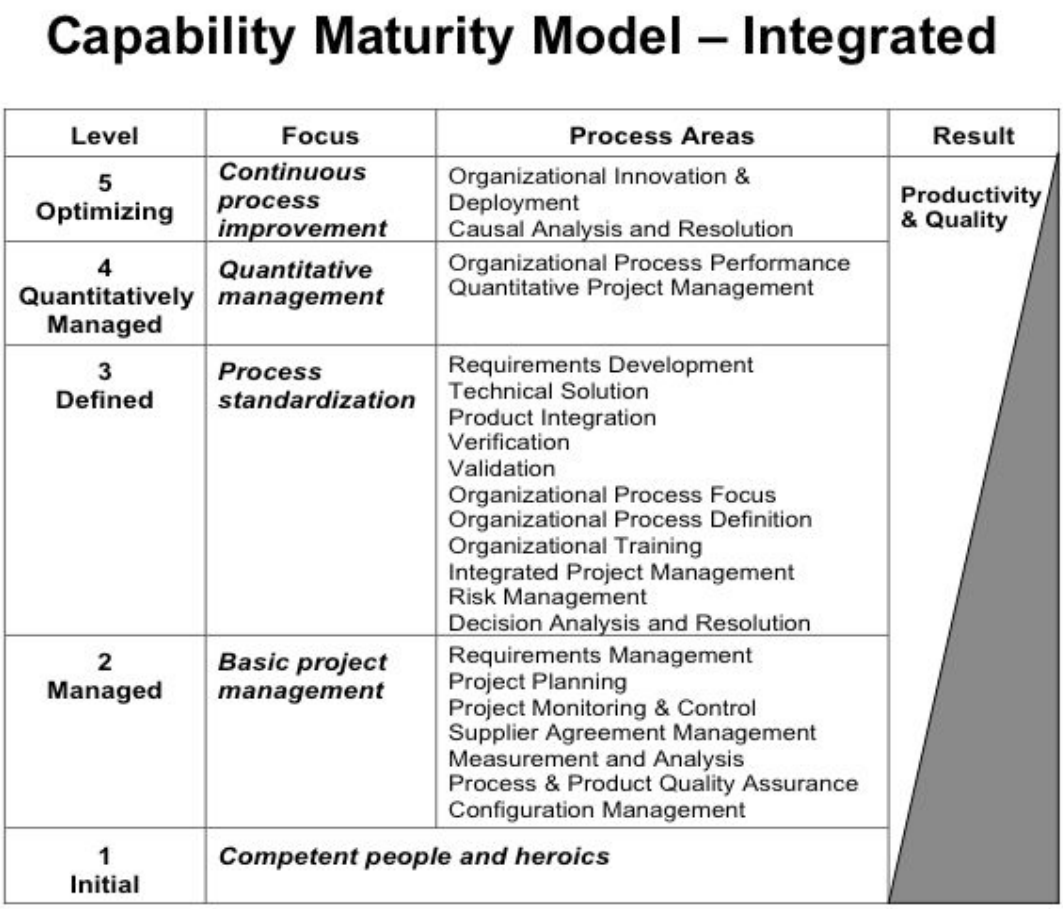

Figure 52. Capability Maturity Model (CMM). Photo Courtesy of Wikipedia

Capability Maturity Model Integration (CMMI) in software engineering and organizational development is a process improvement approach that provides organizations with the essential elements for effective process improvement. It can be used to guide process improvement across a project, a division, or an entire organization. CMMI helps integrate traditionally separate organizational functions, set process improvement goals and priorities, provide guidance for quality processes, and provide a point of reference for appraising current processes [2] CMMI is a model that consists of best practices for system and software development and maintenance. It was developed by the Software Engineering Institute (SEI) at Carnegie-Mellon University. The CMMI model provides guidance to use when developing system and software processes. The model may also be used as a framework for appraising the process maturity of the organization.[1] The root of the CMMI is a scheme for software engineering, but CMMI is highly generalized to embrace other kinds of product, such as the mass manufacture of electronic components. The word software does not appear in definitions of CMMI. This unification of hardware and software engineering makes CMMI extremely abstract. It is not as specific to software engineering as its predecessor. Capability Maturity Model Integration (CMMI) is developed by the CMMI project, which aimed to improve the usability of maturity models by integrating many different models into one framework. The project consisted of members of industry, government and the Carnegie Mellon Software Engineering Institute (SEI). The main sponsors included the Office of the Secretary of Defense (OSD) and the National Defense Industrial Association. CMMI is the successor of the Capability Maturity Model (CMM) or Software CMM. The CMM was developed from 1987 until 1997. In 2002, CMMI Version 1.1 was released. Version 1.2 followed in August 2006.

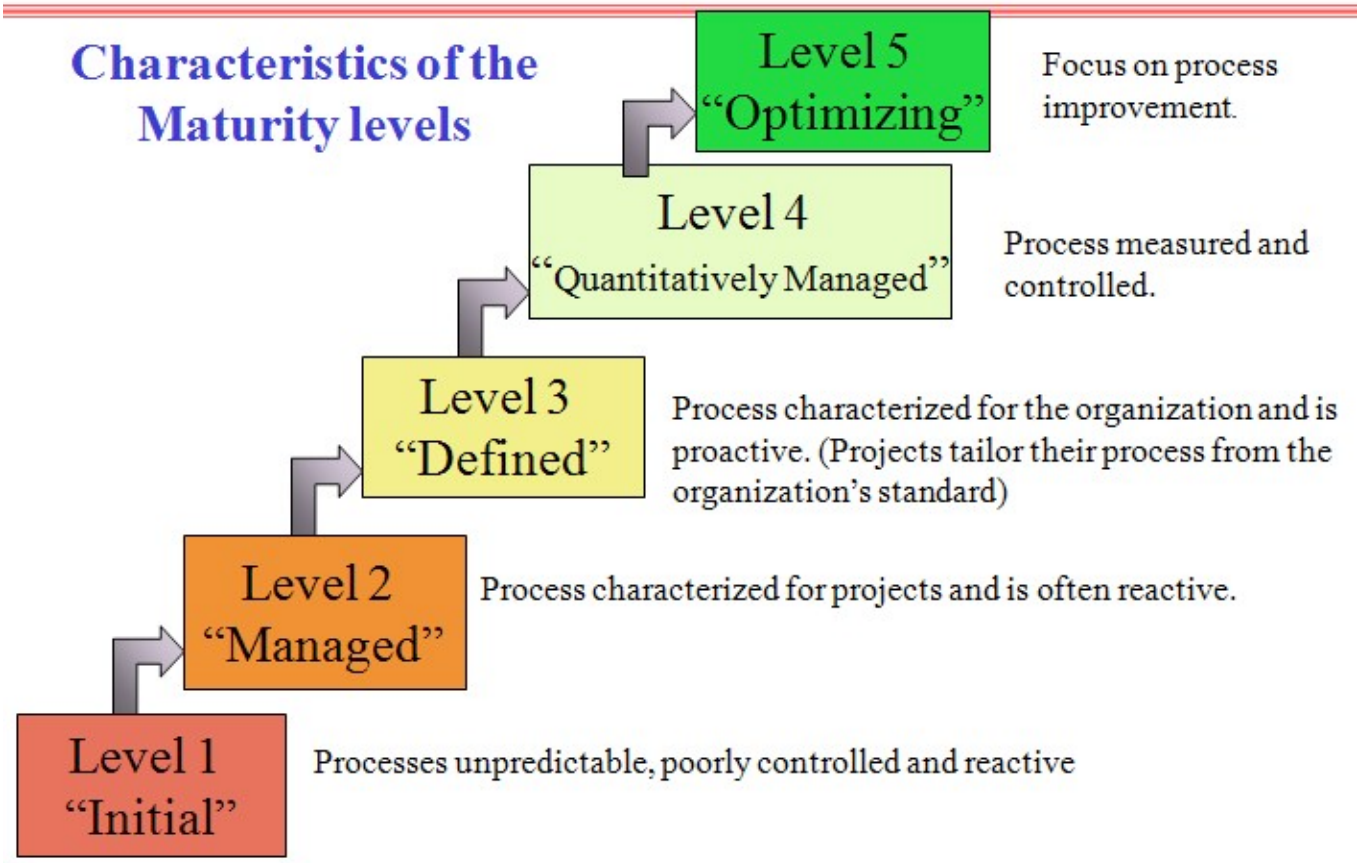

Figure 53. Capability Maturity Model Integration (CMMI). Photo Courtesy of Wikipedia.

We now consider: The Personal Software Process extension to the PMBOK guide as it was developed by the Software Engineering Institute. The Personal Software Process which is a subset of the Capability Maturity Model (CMM) processes, readily applicable to individual software engineers. It was first defined in 1994 by Watts Humphrey in his book A Discipline for Software Engineering (Addison Wesley Professional, Massachusetts, 1994) as part of the Software Process Program of the Software Engineering Institute at Carnegie Mellon University. The PSP is a quantified method aimed to the improvement of the quality and productivity of the personal work of individual software engineers. "Personal Software Process" and "PSP" are registered service marks of the Carnegie Mellon University[1]The PSP philosophy is largely based on reviews at every stage of the development cycle. Before code is written, an outline of the desired behavior is written. That description is 'implemented' in pseudocode, and then each line of pseudo code is implemented in the target language. Only when the entire unit of code is completely written, analyzed and reviewed, is it compiled and run. It is expected to compile and run first time. If it does not, every error, including syntax errors, needs a root cause analysis. The philosophy is that by manually examining the code in such detail to exclude all detectable errors, a better design will be produced than would be produced by a code-compile-fix cycle. PSP is like applying Six Sigma to Software Development. Mukesh Jain led large scale deployment of PSP/TSP in Microsoft India. Within 6 months, more than 2/3 of the projects shipped were without any defects and 94% of the projects were delivered on time. You can freely download: The Personal Software ProcessSM (PSPSM) Body of Knowledge, Version 1.0 @ http://en.wikipedia.org/wiki/Personal_Software_Process

An SEI Affiliate Opportunity: Team: Personal Software Process[SM]/Team Software Process[SM] Strategic Initiative Team leader: Jim Over. Summary of Opportunity @ http://www.sei.cmu.edu/collaborating/affiliates/psp.html.

The Personal Software Process [SM] (PSP[SM]) is an SEI technology that brings discipline to the practices of individual software engineers, dramatically improving product quality, increasing cost and schedule predictability, and reducing development cycle time for software. The Team Software Process[SM] (TSP[SM]) extends and refines PSP methods to guide engineers in their work on development and maintenance teams. It shows them how to build a self-directed team and how to perform as an effective team member. It also shows management how to guide and support these teams and how to maintain an environment that fosters high team performance.

The goals of this initiative are to improve the practice of software engineering by transitioning the PSP and TSP into widespread use and to establish a self-sustaining infrastructure for propagating and supporting the PSP and TSP. We seek organizations with an interest in applying PSP and TSP to project teams that are also interested in working with the SEI to improve the PSP/TSP transition

package. The package includes:

- training for engineers, instructors, and managers
- transition strategies and plans
- tools

Results to be Accomplished

The desired result of an affiliate's participation with the PSP/TSP team is a successful transition of the Personal Software Process and Team Software Process into the sponsoring organization and an improved PSP/TSP transition package. The sponsoring organization will also have at least one trained PSP instructor and TSP launch coach with in-depth knowledge of how to successfully transition PSP and TSP into an organization.

Potential Affiliates Tasks and Responsibilities

An affiliate with the PSP team would

- complete the PSP course, becoming an authorized PSP instructor
- be trained to act as a TSP launch coach
- participate in the development of one or more aspects of the PSP/TSP transition package
- participate with the SEI in the transition of PSP and TSP into one or more small project teams in the affiliate's organization
- identify requirements for technology to support PSP and TSP
- work with the SEI to analyze project data and evaluate the effects of PSP and TSP on the organization's project team
- identify and document the results of the pilot study, including barriers to introduction and recommended mitigation steps

For More Information

To find out more or inquire about participating as an affiliate, contact

Affiliate Program Administrator

Software Engineering Institute

Carnegie Mellon University

4500 Fifth Avenue

Pittsburgh, PA 15213-2612

Phone: 412-268-3980

FAX: 412-268-5758

E-mail:affiliate@sei.cmu.edu

How to Convert Open Educational Resources (OER) into an Accredited Online Degree via Excelsior College

Excelsior College

This section will also help you resolve the financial obstacle to a high quality (ivy-league) education and get accreditation. I propose a solution that can liberate the Laser Informed Learner from the financial obstacle to superpower knowledge. The severity of the financial hardship is cutting off a huge portion of the American population from their fundamental right to a complete education. "In 1948, the United Nations proclaimed education to be a fundamental human right. According to Article 26 of the Universal Declaration of Human Rights, that right includes free and compulsory elementary education, and access to technical, professional, and higher education."[251] According to Microtrends @ http://www.microtrending.com/, in 2007 there were 28 million college dropouts in the USA and growing; this group is actually bigger than the entire population of Venezuela (27 million).[252] I believe that the above trend can be reversed through a coupling of the Laser informed Learner to MIT OCW and Excelsior College @ https://www.excelsior.edu/ accredited online degree programs (based out of Albany, NY). Through Excelsior you can convert the knowledge you acquire through MIT OCW into an undergraduate degree for under $10,000. I found Excelsior's program to be exceptionally valuable because of all the tools it provides the independent student. At Excelsior College there are multiple programs that are indispensable for converting MIT knowledge into an official degree at the lowest possible cost.[253]

One such tool is the Credit Bank System (CBS). This Credit Bank System will enable you to acquire and transfer credits from any source or school. Their motto is, "we don't care where you get the knowledge, it is what you know that matters." Another way you will be able to convert your knowledge into an accredited degree is by means of a program called Course Credit by Examination (CCE). Through CCE you will be able to take various exams that are available online and with proctors in different locations throughout the United States. By doing CCE, you can study at your own pace and you can minimize the exuberant costs you would normally have to pay through regular courses or if you take them online or through particular schools. An example of CCE subjects are the Graduate Record Examination (GRE®)[254] for Mathematics, Physics, Chemistry, Computer Science, Biology, Psychology and English. Most of the major subject areas are covered. One exam taken through the GRE, (sponsored by the ETS in Princeton) is equivalent to approximately 30 credits of undergraduate work at Excelsior College. By taking one GRE exam for $130.00, one is able to increase the possibility of getting a degree not only much quicker but definitely more inexpensively, which is one of our major goals. But this program at Excelsior College not only will save you hundreds of thousands of dollars ($300,000) in tuition fees that would cost you to go through the MIT curriculum, here you can literally go through it for under $10,000.

But it's not only the reduction in cost that makes this program highly accessible and exceptional; it is also the tools that they provide to the independent student. For example, their virtual academic library connected to the John Hopkins University gives you academic access to very special reports, books and online professional material required for research in an academic environment.[255] Another important program is the online live tutoring with subject matter experts. That alone reduces a lot of cost in obtaining help in particular areas, particularly in the hard sciences where the work becomes very difficult and rigorous, where a student would definitely need help in navigating through the higher curriculum in mathematics, physics, and chemistry or in computer science. With live tutoring you will not be alone in your efforts to master higher education. This is true value; all this will be included in the low price tag. There is also a virtual laboratory. Now you can do experiments both in physics and in writing. These online virtual laboratories are facilitating experimental work in the hard sciences, so once again, the value is absolutely exceptional. There are valuable services for peer networking, so that a student will no longer be isolated. He or she will be able to access study buddies and connect with other students who are also working toward their degree online. This peer to peer network is also available through MIT OCW and its discussion forums.

Rice University Connexions

Rice University has a wonderful free- textbook building and Print On Demand (POD) website: Connexions is a place to view and share educational material made of small knowledge chunks called modules that can be organized as courses, books, reports, etc. Anyone may view or contribute: authors create and collaborate; instructors rapidly build and share custom collections, learners find and explore content @ http://cnx.org/.

IEEE SPS/Connexions Project

Welcome to the IEEE-SPS/Connexions project information website.

As IEEE Signal Processing Society (SPS) President Alfred Hero announced in the November 2007 IEEE Signal Processing Magazine, that IEEE is embracing the concept of open access and joining a growing worldwide movement of concerned organizations and individuals who aim to democratize access to knowledge and educational materials.

In this project, the IEEE-SPS will be working with the open-access repository project Connexions (http://cnx.org) on a major initiative to develop a critical mass of signal processing educational modules and courses that will be available for free access by anyone, anywhere, at any time. The materials will pass through a careful Society review for quality and content that will earn them the imprimatur of the IEEE brand for quality and eventually will be available not just in English but also in a number of languages, including Spanish and Chinese.

Everyone has knowledge to share. Contribute a two-page module on your favorite topic, a set of interactive simulations, a tech note on a DSP application, the notes from your short course, or your out-of-print textbook (once you've secured the copyright from the original publisher). Translate a module into or out of another language. Volunteer to peer review contributions. Or just tell other people about this new opportunity to energize the signal processing community and knowledge base.

The project will begin accepting submissions of content for conversion and reviewing in January 2008. If you'd like get started early contributing your own content, see the Connexions author's guide at [http://cnx.org/help/ModuleInMinutes].

For more information

IEEE-SPS website | http://www.signalprocessingsociety.org/

Connexions | http://cnx.org

The Library of Congress

The Library of Congress in Washington D.C. is the largest library in the US and it is also making its collection available online. The Library of Congress has made digitized versions of collection materials available online since 1994 @ http://www.loc.gov/library/libarch-digital.html. , concentrating on its most rare collections and those unavailable anywhere else. The following services are your gateway to a growing treasury of digitized photographs, manuscripts, maps, sound recordings, motion pictures, and books, as well as "born digital" materials such as Web sites. In addition, the Library maintains and promotes the use of digital library standards and provides online research and reference services. The Library provides one of the largest bodies of noncommercial high-quality content on the Internet. By providing these materials online, those who may never come to Washington can gain access to the treasures of the nation's library. Such online access also helps preserve rare materials that may be too fragile to handle. Please watch for free on C-Span the: Library of Congress Series on the Digital Future: Collection: Digital Future is a series of eight lectures hosted at the Library of Congress' John W. Kluge Center @http://www.cspanarchives.org/library/index.php?main_page=basic-search&query=-Library+of+Congress+Series+on+the+Digital+Future.

Digital Future: Meaning of Digital

Event Date: 01/31/2005 Last Airing: 03/30/2005 Program Id: 184429-1

People: Derrick De Kerckhove, Deanna Marcum, Brian Cantwell Smith, David Seaman

Mr. Smith combines degrees in computer science and philosophy and is an expert on the interdisciplinary convergence brought about by digitization. His lecture, titled “And Is All This Stuff Really Digital After...

[Encyclopedia of the Library of Congress]

Event Date: 01/30/2006 Last Airing: 05/01/2006 Program Id: 191292-1

People: John Cole, Allan J. Stypeck, Mike Cuthbert, Nicholas A. Basbanes

Co-editor Cole and Mr. Basbanes talked on a radio show about the [Encyclopedia of the Library of Congress], published by Bernan Press. The book covers the history of the Library of Congress and the collections the...

Digital Future: Archiving

Event Date: 12/13/2004 Last Airing: 03/29/2005 Program Id: 184428-1

People: Derrick De Kerckhove, David Weinberger, Deanna Marcum, Abby Smith, Brewster Kahle, Robert S. Martin

Brewster Kahle, digital librarian, director and co-founder of the Internet Archive, talked about capturing material on the Internet and the challenges of selecting pertinent content. Mr. Kahle first developed the...

Digital Future: Quantum Computing

Event Date: 01/24/2005 Last Airing: 03/30/2005 Program Id: 184450-1

People: Derrick De Kerckhove, Deanna Marcum, Juan Pablo Paz, Timothy Eastman

Juan Pablo Paz, a quantum physicist from Buenos Aires, Argentina, who was currently working at the Los Alamos National Laboratory, talked about the future of computers and how quantum computing, in its development...

Digital Future: New Internet Concept

Event Date: 03/28/2005 Last Airing: 04/02/2005 Program Id: 184433-1

People: Derrick De Kerckhove, Deanna Marcum, Neil Gershenfeld, Michael Jon Jensen, James S. Langer

Neil Gershenfeld, director of the Center for Bits and Atoms at the Massachusetts Institute of Technology, author of [When Things Start to Think], published by Owl Books, talked about his concept, Internet Zero (0)....

Digital Future: The Experience of Reading

Event Date: 02/14/2005 Last Airing: 04/01/2005 Program Id: 184430-1

People: Derrick De Kerckhove, Deanna Marcum, Prosser Gifford, David M. Levy, Glen Harris Hoptman

Professor David M. Levy talked about the shift in the experience of reading from the fixed page to movable computer screens and the impact of the shift on language. Mr. Levy was the author of [Scrolling Forward: ...

Digital Future: Distribution of Knowledge

Event Date: 03/14/2005 Last Airing: 04/02/2005 Program Id: 184432-1

People: Derrick De Kerckhove, Deanna Marcum, Edward L. Ayers

Professor Ayers talked about the creation and distribution of knowledge in today’s digital environment. Edward L. Ayers, dean of the College and Graduate School of Arts and Sciences at the University of Virginia,...

Digital Future: Copyright Issues

Event Date: 03/03/2005 Last Airing: 04/01/2005 Program Id: 184431-1

People: Derrick De Kerckhove, Deanna Marcum, Lawrence Lessig, Steven J. Metalitz

Lawrence Lessig, professor of law at Stanford Law School and founder of the Stanford Center for Internet and Society, and author of [Code and Other Laws of Cyberspace], published by Basic Books, talked about the...

Digital Future: Web Logs and Knowledge

Event Date: 11/15/2004 Last Airing: 03/29/2005 Program Id: 184427-1

People: Derrick De Kerckhove, David Weinberger, Deanna Marcum, Robert S. Martin, Erik Delfino

David Weinberger, who served as a senior Internet adviser to the 2004 Howard Dean presidential campaign, talked about the gathering and dissemination of information through Internet web logs, or "blogs." He is a...

Digital Future Conclusion
Event Date: 03/28/2005 Last Airing: 04/02/2005 Program Id: 185455-1

People: Derrick De Kerckhove, Deanna Marcum

Organizers reflected on the eight part series sponsored by the Library of Congress on the future of technology and the potential impact of the digital age.

The Universal Digital Library Million Book Collection

Vision

For the first time in history, all the significant literary, artistic, and scientific works of mankind can be digitally preserved and made freely available, in every corner of the world, for our education, study, and appreciation and that of all our future generations.

Up until now, the transmission of our cultural heritage has depended on limited numbers of copies in fragile media. The fires of Alexandria irrevocably severed our access to any of the works of the ancients. In a thousand years, only a few of the paper documents we have today will survive the ravages of deterioration, loss, and outright destruction. With no more than 10 million unique book and document editions before the year 1900, and perhaps 100 million since the beginning of recorded history, the task of preservation is much larger. With new digital technology, though, this task is within the reach of a single concerted effort for the public good, and this effort can be distributed to libraries, museums, and other groups in all countries.

Existing archives of paper have many shortcomings. Many other works still in existence today are rare, and only accessible to a small population of scholars and collectors at specific geographic locations. A single wanton act of destruction can destroy an entire line of heritage. Furthermore, contrary to the popular beliefs, the libraries, museums, and publishers do not routinely maintain broadly comprehensive archives of the considered works of man. No one can afford to do this, unless the archive is digital.

Digital technology can make the works of man permanently accessible to the billions of people all over the world. Andrew Carnegie and other great philanthropists in past centuries have recognized the great potential of public libraries to improve the quality of life and provide opportunity to the citizenry. A universal digital library, widely available through free access on the Internet, will improve the global society in ways beyond measurement. The Internet can house a Universal Library that is free to the people.

The Internet Archive for Universal Access to human Knowledge

The Internet Archive is a 501(c)(3) non-profit that was founded to build an Internet library, with the purpose of offering permanent access for researchers, historians, and scholars to historical collections that exist in digital format. Founded in 1996 and located in the Presidio of San Francisco, the Archive has been receiving data donations from Alexa Internet and others. In late 1999, the organization started to grow to include more well-rounded collections. Now the Internet Archive includes texts, audio, moving images, and software as well as archived web pages in our collections. Why the Archive is Building an 'Internet Library'

Libraries exist to preserve society's cultural artifacts and to provide access to them. If libraries are to continue to foster education and scholarship in this era of digital technology, it's essential for them to extend those functions into the digital world.

Many early movies were recycled to recover the silver in the film. The Library of Alexandria - an ancient center of learning containing a copy of every book in the world - was eventually burned to the ground. Even now, at the turn of the 21st century, no comprehensive archives of television or radio programs exist.

But without cultural artifacts, civilization has no memory and no mechanism to learn from its successes and failures. And paradoxically, with the explosion of the Internet, we live in what Danny Hillis has referred to as our "digital dark age."

The Internet Archive is working to prevent the Internet - a new medium with major historical significance - and other "born-digital" materials from disappearing into the past. Collaborating with institutions including the Library of Congress and the Smithsonian, we are working to preserve a record for generations to come.

Open and free access to literature and other writings has long been considered essential to education and to the maintenance of an open society. Public and philanthropic enterprises have supported it through the ages.

The Internet Archive is opening its collections to researchers, historians, and scholars. The Archive has no vested interest in the discoveries of the users of its collections, nor is it a grant-making organization.

At present, the size of our Web collection is such that using it requires programming skills. However, we are hopeful about the development of tools and methods that will give the general public easy and meaningful access to our collective history. In addition to developing our own collections, we are working to promote the formation of other Internet libraries in the United States and elsewhere.

The Public Library of Science

Another very important research tool for the open online student and teacher is the Public Library of Science. **"**PLoS **is a nonprofit organization of scientists and physicians committed to making the world's scientific and medical literature a freely available public resource. All our activities are guided by our core principles:** PLoS Core Principles @ http://www.plos.org/index.php.

1. **Open access**. All material published by the Public Library of Science, whether submitted to or created by PLoS, is published under an **open access license** that allows unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

2. **Excellence**. PLoS strives to set the highest standards for excellence in everything we do: in content, style, and aesthetics of presentation; in editorial performance at every level; in transparency and accessibility to the scientific community and public; and in educational value.

3. **Scientific integrity**. PLoS is committed to a fair, rigorous editorial process. Scientific quality and importance are the sole considerations in publication decisions. The basis for decisions will be communicated to authors.

4. **Breadth**. Although pragmatic considerations require us to focus initially on publishing high-impact research in the life sciences, we intend to expand our scope as rapidly as practically possible, to provide a vehicle for publication of other valuable scientific or scholarly articles.

5. **Cooperation**. PLoS welcomes and actively seeks opportunities to work cooperatively with any group (scientific/scholarly societies, physicians, patient advocacy groups, educational organizations) and any publisher who shares our commitment to open access and to making scientific information available for the good of science and the public.

6. **Financial fairness**. As a nonprofit organization, PLoS charges authors a fair price that reflects the actual cost of publication. However, the ability of authors to pay publication charges will never be a consideration in the decision whether to publish.

7. **Community engagement**. PLoS was founded as a grassroots organization and we are committed to remaining one, with the **active participation of practicing scientists** at every level. Every publishing decision has at its heart the needs of the constituencies that we serve (scientists, physicians, educators, and the public).

8. **Internationalism**. Science is international. PLoS aims to be a truly international organization by providing access to the scientific literature to anyone, anywhere; by publishing works from every nation; and by engaging a geographically diverse group of scientists in the editorial process.

9. **Science as a public resource**. Our mission of building a public library of science includes not only providing unrestricted access to scientific research ideas and discoveries, but developing tools and materials to engage the interest and imagination of the public and helping non-scientists to understand and enjoy scientific discoveries and the scientific process."

Student Internship Program @ Laurence Livermore Lab NIF

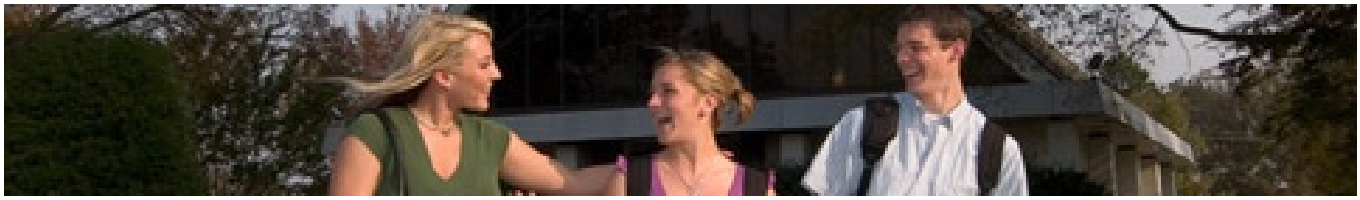

Figure 54.

The NIF and Photon Science Directorate has opportunities for undergraduate and graduate-level students to engage in cutting-edge scientific research to further their education and/or research goals. The Student Internship Program will provide undergraduate and graduate students research opportunities in a large array of fields such as lasers, laser-plasma physics, electro-optics, software development and optical, X-ray and nuclear instrument development and testing. To apply, refer to the LLNL Jobs page. Browse to the "Students & Faculty" category. The current NIF opening is titled "NIF Temporary Intern".For more information about Livermore and the Bay Area, please see the Visiting LLNL page. Contact NIF for more information on our Summer Internship Opportunities.

Assignments

Student(s) will work alongside scientists doing work and research at on-site laser and nuclear facilities in the areas of advanced laser development, laser-plasma interactions, hydrodynamics, material science, radiation physics and various diagnostic systems. Assignments can include the following options:

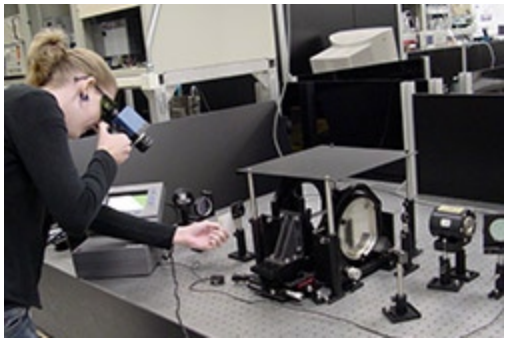

Figure 55.

- Summer: Full-time during the summer academic break
- Co-op: Full-time during an academic semester/quarter
- Year-round: Part-time during the academic year and full-time during the academic breaks

Duties include:

- Conduct research (experimental, theoretical or modeling) in an assigned area
- Communicate research results, document work, present and discuss findings

Figure 56. Internships provide a hands-on research experience on a focused project as well as an introduction to a broad spectrum of ongoing research at LLNL through a series of specially arranged summer lectures. The Student Internship Program is tailored to tap a wide range of scientific talent, encouraging and fostering excellence and attracting quality students to conduct research in the NIF & Photon Science Directorate.

Previous Summer Internship lecture series have included:

- NIF (with a special tour of the NIF laser facility)
- Destination Space Station (lecture by former NASA astronaut and current NIF Principal Deputy Principal Associate Director)
- How to Make and Use “Nuclear” Photons with Lasers
- Inertial Fusion Energy
- The Mercury Laser
- Uncovering Secrets of Stellar Generation
- Antimatter, Fission, Fusion – Which Is Best to Power Spacecraft?
- Laser Peening and its Applications
- Laser Guide Star
- KDP Rapid Crystal Growth

Figure 57.

1.3 MIT OCW SuperPower Knowledge Base, the Democratization of Education and The Wealth Creation System (The Triple Helix)

The explosion of social networking is one of the keystone technologies that are enabling the upgrade to the social knowledge Web 3.0. The Web 2.0 as you have probably experienced through YouTube, MySpace, Technorati, Slashdot, Flikr or FaceBook were the first waves of communication technologies that enabled free collaboration and open sharing of ideas, intellectual content, photos and videos. With the advent of the Web 3.0, more advanced knowledge sharing technologies are becoming available. According to Wikipedia: "Web 3.0 is a term used to describe the future of the World Wide Web. Following the introduction of the phrase "Web 2.0" as a description of the recent evolution of the Web, many technologists, journalists, and industry leaders have used the term "Web 3.0" to hypothesize about a future wave of Internet innovation. Views about the next stage of the World Wide Web's evolution vary greatly. Some believe that emerging technologies such as the Semantic Web will transform the way the Web is used, and lead to new possibilities in artificial intelligence. Other visionaries suggest that increases in Internet connection speeds, modular web applications, or advances in computer graphics will play the key role in the evolution of the World Wide Web." [256] The Semantic web is emerging as the new format for scientific knowledge collaboration of every sort through any device (cell phone, PDA, laptop or desktop) making it more precise and user friendly. Please see an interview with Tim Berners Lee @ MIT http://www.technologyreview.com/video/index.aspx?vid=96&a=f. Read the Article: **A Smarter Web** By John Borland - March 2007. New technologies will make online search more intelligent--and may even lead to a "Web 3.0."

MIT's DSpace is already implementing the web 3.0 concept. Open or public access to MIT's DSpace gives you the opportunity to participate in the USA superpower knowledge base. According to Wikipedia; "DSpace is an open source software package that provides the tools for management of digital assets, and is commonly used as the basis for an institutional repository. It is also intended as a platform for digital preservation activities. Since its release in 2002, as a product of the HP-MIT Alliance, it has been installed and is in production at over 240 institutions around the globe [1], from large universities to small higher education colleges, cultural organizations, and research centers. DSpace supports a wide variety of data, including books, theses, 3D digital scans of objects, photographs, film, video, research data sets and other forms of content. It is shared under a BSD licence, which enables users to customize or extend the software as needed.'[257]

Historically, Thomas Jefferson (founder of the American public education system) designed the superpower knowledge base of the USA to be democratically distributed, but it was hijacked by the privatization of knowledge. Now, thanks to MIT OCW Consortia (the Virtual University) and DSpace the democratic mission of public education is being restored. The MIT Open Course Ware (OCW) program was the result of a question that was posed to Charles M. Vest.. In 1997 as he was doing a campaign fundraiser for the university, he was asked; "what is MIT to do about education over the internet?" This question kept coming repeatedly, so in 1997 Mr. Vest requested an internet task force (MIT faculty) to investigate how MIT should approach the internet. The result was the OCW program or the free publication of its entire course line and curriculum online. It turned out to be the most brilliant decision ever made in the history of higher education.[258]

Lou Gershner the CEO and Chairman of IBM (1993-2000), stated that MIT's decision sent a shockwave through the online community.[259] The educational shock wave was truly felt globally because since the inception of this program online in 2002, MIT has gotten over 63 million visits by 48 million visitors (summer of 2008) from virtually every country[260] and established a global network of universities who are now participating in what they call a Consortia of the best universities in the United States, Europe, Asia, Africa and in Latin America. They're all connecting, translating and freely publishing their courses online. By the end of 2008, there were over 5000 courses published over the internet through the OCW initiative and so the shockwave has profoundly resonated.[261] We can clearly see that there is a profound change or a revolution if you will of how education is being experienced worldwide. With this open knowledge sharing initiative, the historical mission of freely empowering humanity with access to the highest scientific knowledge available is now established. The traditional monopoly and dichotomy of the public-private system can now be eliminated. The public-private education model has its equivalent in the open-proprietary software model. In other words the public education system is to the private system what the open software movement (Linux) is to the proprietary model (Microsoft). So with this initiative, we can now safely say that MIT has truly responded to Jefferson's initial proposal for the empowerment of the American people and the world over. The genuine fulfillment of that grand vision of the public empowerment for a new democracy can now be completely realized.

As this book shows, we are now living in a laser information age that has produced an unprecedented wealth creation system. This system is in general, the result of a productive partnership between 3 sectors of society, the public or government, private industry and non-profit organizations (Universities and Colleges). Sociologists call this structure 'the triple helix or relation between University-Industry-Government. A clear discussion of this powerful model is given in a key article: "The Transformation Of University-Industry-Government Relations: Abstract: A transformation in the functions of university, industry, and government, the "triple helix," is taking place as each institution can increasingly assume the role of the other. The Triple Helix thesis states that the knowledge infrastructure can be explained in terms of these changing relationships. Arrangements and networks among the three institutional spheres provide input and sustenance to science-based innovation processes. In this new configuration, academia can play a role as a source of firm-formation, technological, and regional development, in addition to its traditional role as a provider of trained persons and basic knowledge… Stanford and MIT have become the role models for universities attempting to become progenitors of regional knowledge-based economies."[262] The curriculum that studies this relation at MIT is Science, Technology, and Society (STS): Home > Courses > Science, Technology, and Society. One of the founders of the STS curriculum in the USA is Professor Steven L. Goldman.[263]

In particular, this system is the result of a convergence of 3 major disciplines; state capitalism, technology and university knowledge. All three are fruits of the enlightenment, that period of modern history in which science emerged triumphant and unified with engineering to produce the foundation for our modern scientific culture. However, these 3 disciplines when left to spontaneous (incoherent) or directed coherent growth are a double edge sword. Capital can be highly concentrated in a few hands or widely distributed among an entire population. Technology by itself will empower an individual to be 1000 times more productive and a society or a nation to be equally as productive and as powerfully developed. For example, military technology can be manipulated to terrorize, oppress and destroy a society as well as to defend it.

Knowledge, as Peter Drucker[264] often said, is the source of wealth. Knowledge creation, management, distribution and the productivity of a knowledge worker is the central activity we are all engaged in today. Drucker more precisely illustrated this idea in his seminal book: **The Post Capital Society**. There Drucker stated that knowledge is the central economic resource of the Information Age, with the productivity of knowledge as the main problem to solve. Furthermore, Drucker continues, "the productivity of knowledge work—still abysmally low—will become the economic challenge of the knowledge society. On it will depend the competitive position of every single country, every single industry, every single institution within society," and also every individual.[265] However, we should note that this competitive notion is relevant only within a privatized capitalistic system based on the selfish rivalry of a monetary system that artificially creates scarcity. For a Libertarian Socialist System based on the abundance of open resources and open knowledge production the notion of sharing, cooperation, collaboration and solidarity are more fundamental. Noam Chomsky recognizes participatory economics as a viable path to a post capital society. "Participatory Economics (ParEcon for short) is a type of economy proposed as an alternative to contemporary capitalism. The underlying values ParEcon seeks to implement are equity, solidarity, diversity, and participatory self management. The main institutions to attain these ends are workers and consumers councils utilizing self management decision making methods, balanced job complexes, remuneration according to effort and sacrifice, and participatory planning. The ParEcon vision is spelled out in numerous books, the latest full treatment is **Michael Albert's *ParEcon: Life After Capitalism*.** Some of these books are available, in full, on this site. To explore the site, click on any of the menu links to the left. There you will also find material in many different languages. If this is your first time visiting **The ParEcon Project**, be sure to check out our Introductory Materials." [266]

Even though knowledge is the source of wealth it can be privatized, appropriated and closed via copyrights and patents or publicly distributed through public schools and open systems. These open systems are the main instruments of a fourth discipline called Democracy. For the ultimate establishment of an industrial democracy we will need to implement a combination of ParEcon with the resource-based economy of the Venus Project. But first we must establish a democratic educational condition of equality for the wellbeing of all the people and not just a privileged few as the initial key to harnessing the coherent power of the triple helix in the proper way. A good illustration of the democratic knowledge creation and distribution model emerging on the World Wide Web is given by: **The wealth of networks: how social production transforms markets and freedom / Yochai Benkler.** In this thick academic book, Yale law professor Benkler offers a comprehensive catalog of flashpoints in the conflict between old and new information creators. In Benkler's view, the new "networked information economy" allows individuals and groups to be more productive than profit-seeking ventures. New types of collaboration, such as Wikipedia or SETI@Home, "offer defined improvements in autonomy, democratic discourse, cultural creation, and justice"-as long as government regulation aimed at protecting old-school information monoliths (such as the Digital Millennium Copyright Act) doesn't succeed[267]

It was precisely in the words of Thomas Jefferson,[268] inscribed in the Declaration of Independence, and in his proposal for a public education system, that the seed of the USA's intellectual potential to become the most powerful nation on the planet was established. The superpower seed of knowledge came to fruition with FDR's educational policies in the post WWII era. According to Jefferson and the signers of that founding document, ***"we hold these truths to be self-evident, that all men are created equal, that they are endowed by their creator[269] with certain inalienable rights that among these are life, liberty and the pursuit of happiness…"***[270] Jefferson declared his seminal thoughts about public education in a personal letter to George Wythe. ***"I think by far the most important bill in our whole code, is that for the diffusion of knowledge among the people. No other sure foundation can be devised for the preservation of freedom and happiness... The tax which will be paid for this purpose is not more than the thousandth part of what will be paid to kings, priests and nobles who will rise up among us if we leave the people in ignorance."*** [271]

It was known, back then that only through a well informed and well educated public can a democratic society be possible. And for that purpose we need to strengthen the public education system so that everybody gets the equality of conditions that will give them complete access to their full educational potential. But Thomas Jefferson's public education mission has been highly contested by private capital interest groups (Wall Street) who sought to monopolize the power of knowledge with money. There is a long history of the American people struggling to get access to their knowledge potential and to be free from want. That struggle to be free from the basic necessities of life, like hunger, sickness, and deprivation or poverty is at the heart of the American democratic system of education. We now know that it is only through a genuine democratic distribution of educational knowledge, technology and resources that we will finally free our own people and the entire world.

The successful challenge to Jefferson's democratic knowledge proposal is clearly illustrated in the rise of the private university system and its accomplished monopoly of the knowledge processes in the US. The private university system not only attracted most of the capital, the technology and the best knowledge experts but they also created a profound dichotomy, a schism in the heart of the new democracy, a division that wounded the brains of the people. It was the educational application of that corrupted Machiavellian principle of **"divide and conquer,"** derived from the Latin *divide et impera.*[272] This strategic division created an aristocratic society, a business class of elite groups (economic royalist) that gradually increased their power through the monopoly of educational law, technology (the mass media) and the wealth of the nation, a private banking system (the Federal Reserve System)[273] that excluded the majority of the American population from economic participation in the decision making process and left them in ignorance of the

creation and distribution of its wealth. The division between the public and private education system is not only the main instrument that keeps the masses of the population in ignorance of the wealth creating system (Triple Helix) that they funded with their taxes, it also continues to empower the elite business groups with the monopoly and the advantage of the knowledge power via copyright and patents.[274] And even though we do have successful public universities, like the California system and the Community Colleges, they are nevertheless in the business of transferring public intellectual property into private enterprise, efficiently privatizing advanced knowledge.

You can clearly see evidence of the destructive effect and the inequality that results from the division between the private and public system in the increased polarization of the wealth distribution of the USA, where we see the top 1% of the population with the vast majority of the wealth. We have a little over 450 billionaires,[275] 9 million millionaires, approximately 254 million people in the middle class, professionals, knowledge workers, manufacturers and service people etc. 37 million people legally living in poverty, what we call the working poor, living paycheck to paycheck and another 12 to 20 million undocumented illegal immigrant poor workers.[276] On one side, we see that this polarization of wealth distribution is not an accident; in fact it is the deliberate effect of a skewed tax policy that favors the corporations over the general well-being of the population (Social programs, health care and public education).[277] And it is also the result of massive transfers of public intellectual properties that are created with public funds in our Universities and then it is given to the corporations for the privatization of the knowledge power.[278]

One of the best economic analysis of what has actually happened to the American economy and education in my view is: **THE CONSERVATIVE NANNY STATE: How the Wealthy Use the Government to Stay Rich and Get Richer By Dean Baker**. An Amazon reviewer gives us a concise picture. "It is a myth that the rich, or market conservatives in the author's lexicon, unremittingly favor the operation of free markets with absolutely no government intervention. In fact, quite the opposite is the case. The author examines several key areas that show the lie of the idea that the rich favor free market outcomes.

1. Both the government and professional organizations limit the numbers of doctors, lawyers, and other professionals including the entry of foreigners. At the same time, rampant and/or illegal immigration floods lower-wage employment markets and some technical jobs. On the one hand, wages are artificially high, but suppressed on the other to the detriment of the greater good.

2. The Federal Reserve uses monetary policy to increase unemployment and thereby lower wages of the lesser skilled, while limiting the inflation detested by bankers.

3. Corporations are entirely government creations, yet conservatives obscure that point which permits unchecked CEO pay. In actuality the government could mandate governance rules that would likely curtail CEO pay excesses.

4. Copyright and patent laws in essence grant monopolies to the detriment of the free flow of goods and services, which can in fact be harmful as in the case of restricting the availability of needed medicines.

5. Conservatives support legislation to restrict the ability of individuals to seek redress in courts for harm under the name of tort reform. In actuality law suits are a market form of regulation in lieu of government intervention. They are obviously protecting the rich who trump market principles.

6. Free market advocates supposedly advocate choice. So why is there such fear on the part of private enterprise of people choosing Social Security and/or signing up with Medicare for both health care and prescription drugs? The fact is that private business is highly inefficient compared to those programs and can't really compete. Therefore they look to government to limit choice.

7. True conservatives have always had low regard for gambling and certainly insist on its being heavily taxed. But when it comes to Wall St speculation, which is what day-trading is all about, they turn a blind eye to taxing and thus limiting the undisputed harmful impact of speculative transactions.

There are a few more examples by the author, none of which can be seriously disputed. The book has the tone that things could be different: just point out the hypocrisy of the rich and reform will follow. Really?

The author can hardly be unaware that we live in a class society in which the major institutions for inculcating (indoctrination) the idea that markets are neutral and work for us all, namely educational and media institutions are basically owned or financed by the rich. A few dissenting, fringe views are permitted here and there, but basically major dissent concerning the justness of our society is dealt with swiftly: removal or exclusion from school or job, or flagrant suppression.
The situation is more than just setting forth the facts before the public. Probably never before in our history has market ideology so permeated our society and given the rich so many effective tools to disseminate information favorable to their class interests. As far as any effective forces opposing this situation, can anyone honestly say that the Democrats at this point are willing or even want to reverse any of what the author points out any more than do the Republicans? The answer is no."[279]

This appropriation process by the Wealthy is what Noam Chomsky calls the socialization of cost and risk (Research and Development is very wasteful) and the privatization of profit or state capitalism (socialism or subsidies for the rich corporations and capitalism or investment by the taxpayer)[280.] It is important to realize that all the major technologies and infrastructure of the wealth creation system were publically funded: **Our transportations systems**: subways, highways, airways and waterways. **Our communications systems**: the electromagnetic spectrum, radio, TV, the computer, the microchip, the internet, the laser, fiber and free space optics. **Our healthcare systems**: the National Institutes of Health (NIH), medicine, Medicare, Medicaid, bio-technology,

pharmaceuticals, Health Management organization (HMO). **Our energy systems**: coal, gas, electricity, nuclear power and laser fusion power etc. The result of this massive transfer of public property (the Commanding Heights)[281] has become what Reich calls the hostile takeover of Government or the Commonwealth by Super Capitalism.[282]

On the other side, we also see that our public systems (our infrastructure) is in such neglect (underfunded mandate) that the Army Corps of Engineers[283] estimated that we need to invest at least $2.2 trillion dollars (2009) to bring it up to the standard of the advanced industrial countries like Europe and Japan. According to the World Health Organization,[284] (who measures the health of the 194 countries that are registered in the United Nations), the USA is currently (2007) #37, competing with 3rd world countries, in contrast to France (#1) with its universal health care program. Our public education system is so regressive that according to the UN the USA is in world education #27, competing with an African country as opposed to the advanced European nations who are with Japan in the top 10 of the best in the world. Our public educational system is suffering not only from attention deficit disorder and underfunding but also a deliberate ideological attack. How is it that the university and the private school system in America has become the envy of the world and yet its public system is equivalent in performance to a 3rd world country? This is obviously not the result of ignorant policy makers, the USA knows what works! It is the deliberate result of the systematic assault of the public system by religious, racist and corporate private capital interest groups (movement conservatives or nanny conservatives) and corporate democrats, who want the open system to fail in order to appropriate it completely. According to Chomsky; 'There is a campaign under way to essentially destroy the public education system along with every aspect of human life and attitudes and thought that involve social solidarity. It's being done in all sorts of ways. One is simply by underfunding. So, if you can make the public schools really rotten, people will look for an alternative. Any service that's going to be privatized, the first thing you do is make it malfunction so people can say; "We want to get rid of it. It's not running. Let's give it to Lockheed."[285]

An excellent account of the privatization of Education funding and its disastrous consequence is; **The Student Loan Scam: The Most Oppressive Debt in U.S. History - and How We Can Fight Back (Hardcover) by Alan Michael Collinge. Amazon Review:** An in-depth exploration and exposé of the predatory nature of the student loan industry Alan Collinge never imagined he would become a student loan justice activist. He planned to land a solid job after college, repay his student loan debt, and then simply forget the loans ever existed. Like millions of Americans, however, in spite of working hard, Collinge fell behind on payments and entered a labyrinthine student loan nightmare. High school graduates can no longer put themselves through college for a few thousand dollars in loan debt. Today, the average undergraduate borrower leaves school with more than $20,000 in student loans, and for graduate students the average is a whopping $42,000. For the past twenty years, college tuition has increased at more than double the rate of inflation, with the cost largely shifting to student debt. *The Student Loan Scam* is an exposé of the predatory nature of the $85-billion student loan industry. In this in-depth exploration, Collinge argues that student loans have become the most profitable, uncompetitive, and oppressive type of debt in American history. This has occurred in large part due to federal legislation passed since the mid-1990s that removed standard consumer protections from student loans-and allowed for massive penalties and draconian wealth-extraction mechanisms to collect this inflated debt. Collinge covers the history of student loans, the rise of **Sallie Mae**, and how universities have profited at the expense of students. The book includes candid and compelling stories from people across the country about how both nonprofit and for-profit student loan companies, aided by poor legislation, have shattered their lives-and livelihoods. With nearly 5 million defaulted loans, this crisis is growing to epic proportions. *The Student Loan Scam* takes an unflinching look at this unprecedented and pressing problem, while exposing the powerful organizations and individuals who caused it to happen. Ultimately, Collinge argues for the return of standard consumer protections for student loans, among other pragmatic solutions, in this clarion call for social action.

Paul Krugman, a Princeton economist in his powerful book gives us a clear and full explanation of what has actually happened to our public policies in the last 60 years. **The Conscience of a Liberal by Paul Krugman Starred Review**. "Economist and New York Times columnist Krugman's stimulating manifesto aims to galvanize today's progressives the way Barry Goldwater's The Conscience of a Conservative did right-wingers in 1964. Krugman's great theme is economic equality and the liberal politics that support it. America's post-war middle-class society was not the automatic product of a free-market economy, he writes, but was created... by the policies of the Roosevelt Administration.[286] By strengthening labor unions and taxing the rich to fund redistributive programs like Social Security and Medicare, the New Deal consensus narrowed the income gap, lifted the working class out of poverty and made the economy boom. Things went awry, Krugman contends, with the Republican Party's takeover by movement conservatism, practicing a politics of deception [and] distraction to advance the interests of the wealthy. Conservative initiatives to cut taxes for the rich, dismantle social programs and demolish unions, he argues, have led to sharply rising inequality, with the incomes of the wealthiest soaring while those of most workers stagnate. Krugman's accessible, stylishly presented argument deftly combines economic data with social and political analysis; his account of the racial politics driving conservative successes is especially sharp. The result is a compelling historical defense of liberalism and a clarion call for Americans to retake control of their economic destiny."[287]

Another important book that clarifies what has happened to FDR's public vision for America is: **The Second Bill of Rights: FDR's Unfinished Revolution--And Why We Need It More Than Ever by Cass Sunstein**. Editorial Reviews From Publishers Weekly: "While it doesn't succeed in making Franklin Roosevelt into a constitutional innovator, this disheveled book does bring into focus FDR's forgotten effort to address domestic "security," as WWII neared its climax. Roosevelt's inaugural address of January 11, 1944, asked Congress to adopt a "second Bill of Rights": guarantees of work, adequate housing and income, medical care and education, among others—promises designed to extend the New Deal (and thwart the appeal of communism). The indefatigable Sunstein (*Why Societies Need Dissent*, etc.) sketches Roosevelt's domestic policies and the logistics of the inaugural address (included in full in an appendix), then debates the never-adopted bill's merits, historically as its ideas kicked around in the post WWII-era, and as it might be taken up today. He tends to be scanty on the bill's potential budgetary toll and on the responsibility for one's own welfare that FDR thought the bill's beneficiaries ought to bear. Sunstein roams widely over legal history and precedent, but is focused and clear in showing how FDR sowed the seeds of the Universal Declaration of Human Rights (in whose 1948 drafting Eleanor

Roosevelt played a crucial role) and energetic in discussing this proposal's further possible legacy."[288]

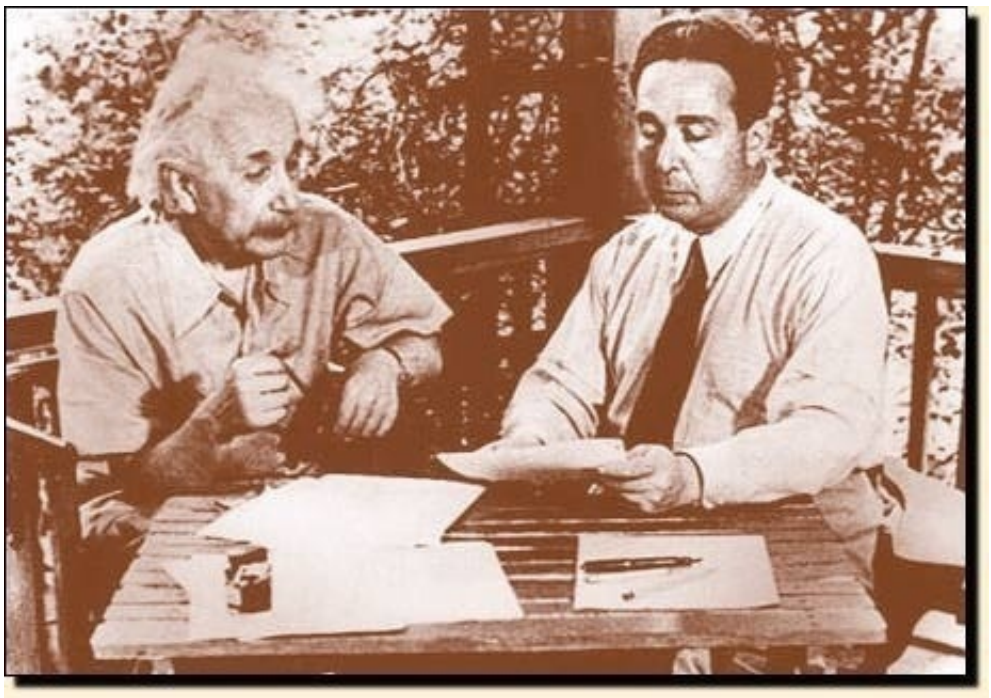

Figure 58. "Because of the danger that Hitler might be the first to have the bomb, I signed a letter to the President which had been drafted by Szilard. Had I known that the fear was not justified, I would not have participated in opening this Pandora's Box, nor would Szilard. For my distrust of governments was not limited to Germany." The photograph shows a postwar reconstruction of the signing. Credit courtesy of aip.org[289]

The value of FDR's public policies becomes even clearer when we examine the rise of the United States as a superpower after WWII. Before WWII, the USA government was not in the business of subsidizing higher education for the general public or funding academic Research and Development so it trailed behind the advanced industrial countries like Germany and Japan who had established the triple helix model of industrial development since the late 19th century and early 20th century.[290] It was Otto Von Bismarck's (1815-1898)[291] educational policy in Germany who first instituted the idea of Government funding academic research that would accelerate the process of converting advanced scientific knowledge into technology and transfer it to industry and the military. He unified Germany, created the first German empire (the 1st Reich) and industrialized the nation. He instituted the idea of Social security, the Welfare State and the universal healthcare system that is still being used today in Germany. The only other country outside of Europe that adopted the German triple helix model of science, engineering education and industrialization before WWII was Japan and it also became an Empire.[292] The USA and most of the European countries' policy of not funding advanced academic research in science and technology nearly resulted in Germany overtaking most of Europe and possibly the entire world. The empire of Japan nearly overtook all of Asia. Again it was Einstein's letter to Franklin Delano Roosevelt in 1939 that sparked a massive transfer of intellectual power from the German intellectuals to the USA, effectively activating the triple helix model in the USA.

Figure 59. Courtesy of the FDR library.

Einstein's Letter to President Franklin Roosevelt[293]

This is the text of the letter signed by Albert Einstein which was delivered to President Franklin Roosevelt by Alexander Sachs on October 11, 1939. The chief author is believed to be Leo Szilard.

Albert Einstein
Old Grove Rd.
Nassau Point
Peconic, Long Island
August 2d, 1939
F.D. Roosevelt
President of the United States
White House
Washington, D.C.
Sir:

Some recent work by E. Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. Certain aspects of the situation which has arisen seem to call for watchfulness and, if necessary, quick action on the part of the Administration. I believe therefore that it is my duty to bring to your attention the following facts and recommendations.

In the course of the last four months it has been made probable--through the work of Joliot in France as well as Fermi and Szilard in America--that it may become possible to set up a nuclear chain reaction in a large mass of uranium, by which vast amounts of power and large quantities of new radium-like elements would be generated. Now it appears almost certain that this could be achieved in the immediate future.

This new phenomenon would also lead to the construction of bombs, and it is conceivable--though much less certain--that extremely powerful bomb of a new type may thus be constructed. A single bomb of this type, carried by boat and exploded in a port, might very well destroy the whole port together with some of the surrounding territory. However, such bombs might very well prove to be too heavy for transportation by air.

The United States has only very poor ores of uranium in moderate quantities. There is good ore in Canada and the former Czechoslovakia, while the most important source of uranium is the Belgian Congo.

In view of this situation you may think it desirable to have some permanent contact maintained between the Administration and the group of physicists working on chain reactions in America. One possible way of achieving this might be for you to entrust with this task a person who has your confidence who could perhaps serve in an unofficial capacity. His task might comprise the following:

a) to approach Government Departments, keep them informed of the further development, and put forward recommendations for Government action, giving particular attention to the problems of securing a supply of uranium ore for the United States.

b) to speed up the experimental work, which is at present being carried on within the limits of the budgets of University laboratories, by providing funds, if such funds be required, through his contacts with private persons who are willing to make contributions for this cause, and perhaps also by obtaining the co-operation of industrial laboratories which have the necessary equipment.

I understand that Germany has actually stopped the sale of uranium from the Czechoslovakian mines which she has taken over. That she should have taken such early action might perhaps be understood on the ground that the son of the German Under-Secretary of State, von Weizaecker, is attached to the Kaiser-Wilhelm-Institut in Berlin where some of the American work on uranium is now being repeated.

Yours very truly
(signed) A. Einstein[294]

Roosevelt correspondence with Einstein and Szilard.

October 19, 1939

My dear Professor:
I want to thank you for your recent letter and and the most interesting and important enclosure.
I found this data of such import that I have convened a Board consisting of the head of the Bureau of Standards and a chosen representative of the Army and Navy to thoroughly investigate the possibilities of your suggestion regarding the element of uranium.
I am glad to say that Dr. Sachs will cooperate and work with this Committee and I feel this is the most practical and effective method of dealing with the subject.
Please accept my sincere thanks.
Very sincerely yours,
(signed) Franklin D. Roosevelt[295]
Dr. Albert Einstein,
Old Grove Road,
Nassau Point,
Peconic, Long Island,
New York.

The committee turned to Vannevar Bush—the director of the Office of Scientific Research and Development—to study Einstein's concerns. From this committee came the Manhattan project[296] which resulted in the atomic bomb. With the atomic bomb came the recognition of the awesome power that's inherent in academic research.

In 1944, the productive outcome of this commission prompted FDR to send a letter to Vannevar Bush,[297] an MIT professor. This letter is in my view perhaps the most powerful education message in contemporary American history—

PRESIDENT ROOSEVELT'S LETTER

THE WHITE HOUSE

Washington, D. C.

November 17, 1944

DEAR DR. BUSH: The Office of Scientific Research and Development, of which you are the Director, represents a unique experiment of team-work and cooperation in coordinating scientific research and in applying existing scientific knowledge to the solution of the technical problems paramount in war. Its work has been conducted in the utmost secrecy and carried on without public recognition of any kind; but its tangible results can be found in the communiques coming in from the battlefronts all over the world. Some day the full story of its achievements can be told.

There is, however, no reason why the lessons to be found in this experiment cannot be profitably employed in times of peace. The information, the techniques, and the research experience developed by the Office of Scientific Research and Development and by the thousands of scientists in the universities and in private industry, should be used in the days of peace ahead for the improvement of the national health, the creation of new enterprises bringing new jobs, and the betterment of the national standard of living.

It is with that objective in mind that I would like to have your recommendations on the following four major points:

First: What can be done, consistent with military security and with the prior approval of the military authorities, to make known to the world as soon as possible the contributions which have been made during our war effort to scientific knowledge?

The diffusion of such knowledge should help us stimulate new enterprises, provide jobs for our returning servicemen and other workers, and make possible great strides for the improvement of the national well-being.

Second: With particular reference to the war of science against disease, what can be done now to organize a program for continuing in the future the work which has been done in medicine and related sciences?

The fact that the annual deaths in this country from one or two diseases alone are far in excess of the total number of lives lost by us in battle during this war should make us conscious of the duty we owe future generations.

Third: What can the Government do now and in the future to aid research activities by public and private organizations? The proper roles of public and of private research, and their interrelation, should be carefully considered.

Fourth: Can an effective program be proposed for discovering and developing scientific talent in American youth so that the continuing future of scientific research in this country may be assured on a level comparable to what has been done during the war?

New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we have waged this war we can create a fuller and more fruitful employment and a fuller and more fruitful life.

I hope that, after such consultation as you may deem advisable with your associates and others, you can let me have your considered judgment on these matters as soon as convenient - reporting on each when you are ready, rather than waiting for completion of your studies in all.

Very sincerely yours,

(s) FRANKLIN D. ROOSEVELT

Dr. VANNEVAR BUSH,

OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
1530 P Street, NW.
Washington 25, D.C.
JULY 25, 1945

DEAR MR. PRESIDENT:

In a letter dated November 17, 1944, President Roosevelt requested my recommendations on the following points:

(1) What can be done, consistent with military security, and with the prior approval of the military authorities, to make known to the world as soon as possible the contributions which have been made during our war effort to scientific knowledge?

(2) With particular reference to the war of science against disease, what can be done now to organize a program for continuing in the future the work which has been done in medicine and related sciences?

(3) What can the Government do now and in the future to aid research activities by public and private organizations?

(4) Can an effective program be proposed for discovering and developing scientific talent in American youth so that the continuing future of scientific research in this country may be assured on a level comparable to what has been done during the war?

It is clear from President Roosevelt's letter that in speaking of science that he had in mind the natural sciences, including biology and medicine, and I have so interpreted his questions. Progress in other fields, such as the social sciences and the humanities, is likewise important; but the program for science presented in my report warrants immediate attention.

In seeking answers to President Roosevelt's questions I have had the assistance of distinguished committees specially qualified to advise in respect to these subjects. The committees have given these matters the serious attention they deserve; indeed, they have regarded this as an opportunity to participate in shaping the policy of the country with reference to scientific research. They have had many meetings and have submitted formal reports. I have been in close touch with the work of the committees and with their members throughout. I have examined all of the data they assembled and the suggestions they submitted on the points raised in President Roosevelt's letter.

Although the report which I submit herewith is my own, the facts, conclusions, and recommendations are based on the findings of the committees which have studied these questions. Since my report is necessarily brief, I am including as appendices the full reports of the committees.

A single mechanism for implementing the recommendations of the several committees is essential. In proposing such a mechanism I have departed somewhat from the specific recommendations of the committees, but I have since been assured that the plan I am proposing is fully acceptable to the committee members.

The pioneer spirit is still vigorous within this nation. Science offers a largely unexplored hinterland for the pioneer who has the tools for his task. The rewards of such exploration both for the Nation and the individual are great. Scientific progress is one essential key to our security as a nation, to our better health, to more jobs, to a higher standard of living, and to our cultural progress.

Respectfully yours,

(s) V. Bush, Director

Vannevar responded back to FDR with a thorough plan to adopt, fund and organize FDR's request. This led in 1945 to the establishment of the National Science Foundation (NSF), the detonation of the atomic bomb and the National Institutes of Health (NIH).[298] The success of the Manhattan project research, the nuclear atomic bomb and the subsequent emergence of America as a superpower were the result in great part of a massive brain drain out of Germany during Hitler's persecution of the socialist and the intellectuals, like Einstein, who was actually just the tip of the iceberg with other advanced mathematicians, political scientists and

engineers. This massive transfer of intellectual power coming out of Germany resulted in University positions in the US. They were the spear leaders and the new empowerment of the U.S., through whom the 2nd World War was won.

It is well known, that it was through the MIT radiation lab where advanced radars were invented with the capability to decode (thanks to the deciphered enigma code by Alan Turing in England) the plans and communication transmissions of the Germans and Japanese that we were able to win the war. The atomic explosions over Japan actually ended the war. "Radar is a system that uses electromagnetic waves to identify the range, altitude, direction, or speed of both moving and fixed objects such as aircraft, ships, motor vehicles, weather formations, and terrain. The term RADAR was coined in 1941 as an acronym for Radio Detection and Ranging. The term has since entered the English language as a standard word, radar, losing the capitalization in the process. Radar was originally called RDF (Radio Direction Finder) in Britain." Both the 1953 invention of the MASER (Microwave Amplification by Stimulated Emission of Radiation) and the 1960 LASER (Light Amplification by Stimulated Emission of Radiation) were developments of Radar technology.[299] The subsequent publication of the MIT RAD LAB SERIES became the foundation of an American and global revolution in science education. The following is an MIT report about the historical role of the MIT RAD LAB.

"After the end of World War II, the United States government continued to pay key people who had worked at the Radiation Laboratory for six months to enable them to write about their work. From the forward of each book: The tremendous research and development effort that went into the development of radar and related techniques during World War II resulted not only in hundreds of radar sets for military (and some for possible peacetime) use but also in a great body of information and new techniques in the electronics and high-frequency fields. Because this basic material may be of great value to science and engineering, it seemed most important to publish it as soon as security permitted.

However, an altruistic drive to publish the Lab's achievements in open literature was not the only impetus. As C. C. Bissell observes: The imposing 27-volume [sic] Radiation Lab Series was not only a technological statement, but also a political statement about the role the United States was to play in the post-war world... that in the post-war world the United States would be the intellectual driving force of science and technology, as well as the economic and political super power."[300]

After the watershed publication of the RAD LAB Series, MIT pioneered the effort to formalize its content and integrate it into a new engineering science curriculum. According to Charles M. Vest "Subjects were redeveloped on a base of science, and new teaching materials—lecture notes, problem sets, and experiments—were generated throughout MIT. In due course, much of this formalized as published textbooks and textbook series. But what really propagated the engineering science revolution was the rapidly increasing number of PhDs educated at MIT joining faculties of universities and colleges all across the country. They brought with them the new lecture notes, draft textbooks, problem sets, and laboratory experiments. These new professors adapted the MIT teaching materials to their new environments. They added to them, subtracted from them, and used them to teach at varying paces. This merged into developing programs at many universities, and before long the nature and quality of engineering education was elevated across the country… So it seemed instantly clear that in 1999 a well-developed initiative could have a similar impact worldwide, at "Internet speed", and without recent MIT graduates as intermediaries. I became an instant and passionate advocate for the initiative that became MIT Open Courseware"[301] It is extremely important to realize that with the advent of the MIT Open Course Ware[302] in 2002, Mr. Vest and the MIT faculty are now democratically extending the superpower knowledge revolution throughout the World Wide Web. Even though MIT is a private University, through its OCW program it has responded truthfully to the Jeffersonian public education tradition. MIT's democratic revolution is now in the business of transferring the wealth creation system (the triple helix) and its super power knowledge base to all humanity.

Other major opportunities for the USA came not only from the demise of Germany and its brain drain but also from the mass destruction of European infrastructure and the death of over 60 to 100 million people who held the world global leadership at the time. Along with this massive destruction, the U.S. was left intact and was encouraged to accelerate its manufacturing of military capability. This increase of the academic military industrial complex[303] and the consequent profiteering of the war caused the USA to emerge out of its depression by producing a lot of new jobs.[304] And so, the commercialization of the war empowered the USA economically and through it emerged as a military empire. Those economic gains were so profitable that it created a permanent war economy. So that today we are spending over 1 Trillion dollars on the congressional, academic and military industrial complex, which is the greatest expenditure of our Gross Domestic Product (GDP).[305] MIT continues to be the main recipient of R & D dollars for the Military industrial complex.[306]

Fully cognizant of the intellectual power inherent in the German triple helix model for industrial development, the USA intelligently decided to share it with Europe and Japan so that they could quickly recover from the war. The transfer of knowledge, technology and capital was embedded in the Marshal Plan[307] for Europe and the Dodge Plan[308] for Japan. Also included in this package was FDR's most powerful democratizing politics, his New Deal legislation. The recovery was so successful that within 30 years both Japan and Europe were not only fully functional but also super wealthy. According to Chomsky; "Britain, France and Italy defaulted on U.S. debts in the 1930s: Washington "forgave (or forgot)," the Wall Street Journal reports. After World War II, there was massive flow of capital from Europe to the United States. Cooperative controls could have kept the funds at home for postwar reconstruction, but policy makers preferred to have wealthy Europeans send their capital to New York banks, with the costs of reconstruction transferred to U.S. taxpayers. The device was called "the Marshall Plan," which approximately covered the "mass movements of nervous flight capital" that leading economists had predicted, and that took place."[309]

For the USA, the potent combination of FDR's equalizing social policies in conjunction with the militarization of science, engineering or technology and educational policy resulted in such a stupendous power grab on a global scale that it was immediately succeeded after the war with the GI Bill.[310] In the 1950's the GI bill was the de facto beginning of a massive declaration of education

for the great majority of Americans. This opened up higher education for the veterans coming out of the war at first, but then it was professed to be good for everybody else (grants and tuition assistance programs followed). The GI bill is considered to be the primary engine of this massive upgrade of the population towards the middle class status because now everybody had access to higher education. The extension of FDR's democratic policies to the education department also created the most egalitarian society in American history and the developed nations the world over.[311] This public funding of the population for higher education resulted in the raising of the standard of living for most Americans at the time, creating the biggest middle class ever in history. In a Wikiquote, Peter Drucker summarizes the true value of FDR's educational policy. "The postwar [WWII] GI Bill of Rights--and the enthusiastic response to it on the part of America's veterans--signaled the shift to the knowledge society. Future historians may consider it the most important event of the twentieth century. We are clearly in the midst of this transformation; indeed, if history is any guide, it will not be completed until 2010 or 2020. But already it has changed the political, economic and moral landscape of the world." -- Managing in a Time of Great Change (1995)

With more people professionally educated and cultivated. With their acquisition of university knowledge, people became more active participants in the democratic society. This new knowledge empowerment of the people exploded in the 1960's with the student's revolts in Berkeley and university students throughout the nation. This new knowledge also empowered the human, feminist and civil rights movements. The high distribution of the knowledge power energized this new middle class, engaging them in the democratic process. However, a different verdict of this knowledge upgrade of the masses was given by the Trilateral Commission—a group of Wall Street bankers and lawyers working in partnership with public officials from Europe and Japan—established by the Carter administration..[312] For this group by the 1970's a "crisis in democracy" had emerged. [313] The Trilateral Commission asserted its rejection of the democratic knowledge power that had exploded in the 60's so they came up with incoherent educational policies that would curb this crisis in democratic power, both domestically and internationally. There answer to this 'crisis" was Neo-Liberalism or the liberation of capital from its obligation to social programs or society. But before they could implement these new economic policies they had to reverse FDR's democratic distribution of the wealth creation system. This agenda was initiated by Nixon with the breakup of the Bretton Woods system of international regulation of capital and rigorously implemented by the Reagan administration. They accomplished the demolition of FDR's public vision through successive administration until the end of the Neo-Liberal era (1971-2008). According to "Joseph Stiglitz: The Fall of Wall Street is to Market Fundamentalism[314] What the Fall of the Berlin Wall Was to Communism, interview with Nathan Gardels, The Huffington Post, September 16, 2008."[315]

According to Wikipedia: "Neoliberalism seeks to transfer control of the economy from the state to the private sector[3] The definitive statement of the concrete policies advocated by Neoliberalism is often taken to be John Williamson's[4] "Washington Consensus", a list of policy proposals that appeared to have gained consensus approval among the Washington-based international economic organizations (like the International Monetary Fund (IMF) and World Bank). Originally coined by its critics and opponents, "Neoliberalism" is a label referring to the recent reemergence of economic liberalism or classical liberalism among political and economic scholars and policy-makers. The label is usually used by people who oppose liberalism; proponents usually describe themselves simply as "liberals". Liberalism supports free markets, free trade, and decentralized decision-making.[316] The term Washington Consensus was initially coined in 1989 by John Williamson to describe a set of ten specific economic policy prescriptions that he considered to constitute a "standard" reform package promoted for crisis-wracked developing countries by Washington D.C based institutions such as the International Monetary Fund (IMF), World Bank and the U.S. Treasury Departmen[t.][1]

Subsequently, as Williamson himself has pointed out, the term has come to be used in a different and broader sense, as a synonym for market fundamentalism; in this broader sense, Williamson states, it has been criticized by writers such as George Soros and Nobel Laureate Joseph E. Stiglitz.[2] The Washington Consensus is also criticized by others such as some Latin American politicians and heterodox economists. The term has become associated with neoliberal policies in general and drawn into the broader debate over the expanding role of the free market, constraints upon the state, and US influence on other countries' national sovereignty. Stabilize, privatize, and liberalize" became the mantra of a generation of technocrats who cut their teeth in the developing world and of the political leaders they counseled[3].—Dani Rodrik, *Professor of International Political Economy,* Harvard University*"*[317]

Noam Chomsky's historical assessment of Neoliberalism and the Trilateral organization is truly on target. "There is a recent (1977) and quite interesting study put out by the Trilateral Commssion: The Crisis of Democracy, by Michel Crozier, Samuel Huntington, and Joji Watanuki --[318] in which an international group of scholars and others discuss what they see as contemporary threats to democracy. One of these threats is posed by "value-oriented intellectuals" who, as they correctly point out, often challenge the institutions that are responsible for "the indoctrination of the young" -- an apt phrase. The student movement contributed materially to this aspect of "the crisis of democracy."[319] The USA global planners intended their policies to be effective all over the world. So again, they partnered with Europe and Japan. The USA was in charge of the North, Central and South America. Europe was responsible for Africa and the Middle East. And Japan was to dominate Asia. The principle objective was to control the democratic distribution of the wealth creation system because this is the core of power and development. According to them this power is preserved for the "masters only and not for the slaves."

The neoliberal behavior of the USA is best illustrated in a talk by Noam Chomsky entitled Kicking Away the Ladder: Corporate Economics vs Democracy. [320] This talk is actually based on a book by the same title: Kicking Away the Ladder: Development Strategy in Historical Perspective by Ha-Joon Chang.[321] This important book answers a fundamental question; how did the rich countries really become rich? Chang continues the development of this idea with an updated study of the infant industry theory of protectionist development invented by Alexander Hamilton[322] in his new book: Bad Samaritans: The Myth of Free Trade and the Secret History of Capitalism. (December 26, 2007). According to Wikipedia "Alexander Hamilton is sometimes considered the "patron saint" of the American School of economic philosophy that, according to one historian, dominated economic policy after 1861.[105] He firmly supported government intervention in favor of business, after the manner of Jean-Baptiste Colbert, as early as the

fall of 1781.[106] Hamilton opposed the British ideas of free trade which he believed skewed benefits to colonial/imperial powers and was in favor of U.S. protectionism which he believed would help develop the fledgling nation's emerging economy. Henry C. Carey was inspired by his writings. Some say[who?] he influenced the ideas and work of German Friedrich List. Friedrich List (August 6, 1789 – November 30, 1846) was a leading 19th Century German and American economist who developed the "National System" or what some would call today the National System of Innovation.[323] He was a forefather of the German Historical school of economics.[1] The National Innovation System (A.k.a. NIS, National System of Innovation) is the flow of technology and information among people, enterprises and institutions which is key to the innovative process on the national level. According to innovation system theory, innovation and technology development are results of a complex set of relationships among actors in the system, which includes enterprises, universities and government research institutes" (The triple Helix).[324] With self-knowledge of the triple helix, the USA did an effective job of restricting the transfer of knowledge, technology and capital to Latin America, the result has been massive under development. Instead they exported, installed, trained, and supported brutal dictatorships and fascist leaders.[325]

Clear evidence of the USA behavior is shown in**; The Washington Connection and Third World Fascism by Noam Chomsky and Edward S. Herman published by South End Press, 1979. The Dominican Republic: U.S. Model for Third World Development @ http://www.chomsky.info/-books.htm**. For a clear and concise examination of American foreign policy for Latin America read: **On Power and Ideology: The Managua Lecture by Noam Chomsky.** Two Amazon reviewers give us an excellent summary of Chomsky's powerful book. 'In this case, the focus is on the bloody recent history of Central America and Washington's role in it. The amazing point with such efforts is how close to the surface truth actually lies and how easily official myths can be exposed. Yet - also - how habitual it is for our intelligentsia to ignore these political unpleasantries, such as CIA sponsored slaughter in Central America…That main point being: that behind all Washington's official praise for human rights lies one non-democratic "right" that determines all the rest and guides our policy makers, namely the "right" of American investment to go where it wants and do what it wants. (Considering the devastating effect the North American Free Trade Agreement (NAFTA),[326] the World trade organization (WTO),[327] and other trade agreements have had on working America and the environment, this is a revealing point to make.) Other rights can be seen as secondary and of instrumental value only to this one overriding imperial drive. This is not a book for the faint-hearted. Be prepared to learn about our hidden history… What makes this book so enlightening is his research material, which includes declassified internal White House; documents…This book will enlighten you on the inherently duplicitous nature of our government's practice of power. What may be hard to swallow for most are the mechanisms (which are nothing more than our conventional institutions) by which Americans are manipulated. Not to mention the practice of the redefinition of words and terms such as "communism" and "defense of democracy" that are designed to push our patriotic buttons, thus enabling our government to carryout overt actions that have dark covert intentions."[328]

Domestically the global managers also restricted the transfer of power to the public system by increasing incarceration for the "superfluous population" (the poor, the Blacks and Hispanics), reduced the educational grants and substituted it with subsidies for Credit Card companies. Through these policies they extended the triple power (knowledge, capital and technology) to the private corporate system, feeding thereby the development of super capitalism or rather **THE CONSERVATIVE NANNY STATE**.[329] They also reversed FDR's egalitarian policies and so it has regressed the country to the inequality of the gilded age (the 1920's).[330] Europe did an effective job of restricting the transfer of power to Africa and the Middle East and the result has been devastating to those regions. But the Europeans refused to implement the regressive policies on their own people and kept applying FDR's social programs, so today they continue to enjoy an excellent education, infrastructure and health care system. Japan refused to implement the selfish policies domestically and internationally, and so transferred the triple helix to all the tigers, the result has been a development boom for most of Asia (China, Taiwan, Singapore, South Korea) etc. Domestically, in addition to the privatization of knowledge power via the Bayh-Dole Act, there were three major weapons employed in this war against the democratization of knowledge. They were ideological, financial and the mass media or propaganda system. Propaganda," says Noam Chomsky "in: **Media Control: The Spectacular Achievements of Propaganda (Open Media Series),** is to a democracy what the bludgeon is to a totalitarian state"--in other words, the means by which leaders keep the masses in line. In this slim pamphlet, he looks at American propaganda efforts, from the warmongering of Woodrow Wilson to the creation of popular support for the 1991 military intervention in Kuwait, and reveals how falsification of history, suppression of information, and the promotion of vapid, empty concepts have become standard operating procedure for the leaders of the United States--both Democrats and Republicans--in their efforts to prevent citizens from raising awkward questions about U.S. policy."[331]

Ideologically one way to undermine democracy was through the establishment of education policies that would indoctrinate as opposed to educate the people. This policy of indoctrination is very important to understand because this was the way to control the newly liberated instinct of freedom that emerged during the 60's. People who discovered their empowerment through higher education were now speaking actively, participating and demanding their human rights. The elite groups were severely threatened by this massive up rise in educated people, because they challenged the established controls of government and capital interest groups. So to offset this newly liberated power of thinking, the policy of indoctrination serves as an instrument of instruction that imposes a way of thinking that is uncritical, passive, obedient, servile, atomized and de-politicized. This is the key mental strategy of the ideological attack on the public education system and its one of the fundamental policies that is underwriting the effort to undermine the education process in the public sphere. **Seymour Papert**, an MIT math educator for the Media Lab has done a wonderful job in describing how the dis-empowerment of the public school system actually happened. "At MIT a key to understanding why School is what it is lies in recognizing a systematic tendency to deform ideas in specific ways in order to make them fit into a pedagogical framework. One of these deformations is described here as "**disempowering ideas**." The insight leads to a new direction for innovation in education: re-empowering the disempowered ideas. Doing so is not easy: it needs a new epistemology with a focus on power as a property of ideas and a challenge to the School culture. On the positive side, the insight also leads to a new vision of what technology can offer education.'[332]

Research and Theories

At MIT, Papert went on to create the Epistemology and Learning Research Group at the MIT Media Lab [2]. Here, he was the developer of an original and highly influential theory on learning called constructionism, built upon the work of Jean Piaget in Constructivism learning theories. Papert worked with Jean Piaget during the 1960s and is widely considered the most brilliant and successful of Piaget's protégés; Piaget once said that "no one understands my ideas as well as Papert." Papert has rethought how schools should work based on these theories of learning. Papert has also been widely known for focusing on the impact of new technologies on learning in general and in schools as learning organizations in particular. To this end, Papert used Piaget's work while developing the Logo programming language while at MIT. He created Logo as a tool to improve the way that children think and solve the problems. A small robot called the "Logo Turtle" was developed and children have been encouraged to solve the problem with the Logo turtle. A main purpose of the Logo Foundation research group is to strengthen the ability to learn knowledge. Papert insists a language or program that children can learn -- like Logo -- does not have to lack functionality for expert users. As part of his work with technology, Papert has been a proponent of the Knowledge Machine. He is also currently one of the principals for the One Laptop Per Child (figure 60) initiative to manufacture and distribute The Children's Machine in developing nations.

He has also been collaborator with Lego on their Logo-programmable Lego Mindstorms robotics kits. Papert has been called by Marvin Minsky "the greatest living mathematics educator."[3] 333 LEGO Mindstorms is a line of Lego sets combining programmable bricks with electric motors, sensors, Lego bricks, and Lego Technic pieces (such as gears, axles, and beams). Mindstorms originated from the programmable sensor blocks used in the line of educational toys. The first retail version of Lego Mindstorms was released in 1998 and marketed commercially as the Robotics Invention System (RIS). The current version was released in 2006 as Lego Mindstorms NXT. The hardware and software roots of the Mindstorms Robotics Invention System kit go back to the programmable brick created at the MIT Media lab. This brick was programmed in Brick Logo. The first visual programming environment, called LEGOsheets,[1] for this brick was created by the University of Colorado in 1994 and was based on AgentSheets. The original Mindstorms Robotics Invention System kit contained two motors, two touch sensors, and one light sensor. The NXT version has three servo motors and four sensors for touch, light, sound, and distance. Lego Mindstorms may be used to build a model of an embedded system with computer-controlled electromechanical parts. Many kinds of real-life embedded systems, from elevator controllers to industrial robots, may be modeled using Mindstorms. Mindstorms kits are also sold and used as an educational tool, originally through a partnership between Lego and the MIT Media Laboratory.[2][3] The educational version of the products is called Lego Mindstorms for Schools, and comes with the ROBOLAB GUI-based programming software, developed at Tufts University[4] using the National Instruments LabVIEW as an engine. The only difference between the educational series, known as the "Challenge Set", and the consumer series, known as the "Inventor Set", is another included light sensor and several more gearing options. Mindstorms is named after the book Mindstorms: Children, Computers, and Powerful Ideas by Seymour Papert.[5]

Figure 60. The XO-1, previously known as the "$100 Laptop" or "Children's Machine", is an inexpensive laptop computer designed to be distributed to children in developing countries around the world,[31] to provide them with access to knowledge, and opportunities to "explore, experiment and express themselves" (constructionist learning).[32] The laptop is developed by the **One Laptop per Child** (OLPC) organization, and manufactured by the Taiwanese computer company, Quanta Computer.

I think that MIT OCW is now extending these empowering educational ideas directly to the public system via: Highlights for High schools and the Community College outreach programs that are revolutionizing the pedagogical model @ Teaching K-12 MIT

Global Education & Career Development Ctr. ♦ 12-170 ♦ (617) 253-4733 ♦ http://careers.mit.edu http://web.mit.edu/career/www/guide/teachingk-12.pdf. Or **The MIT/Wellesley Scheller Teacher Education Program (STEP) @** http://education.mit.edu/drupal/tep/. http://ocw.mit.edu/OcwWeb/hs/home/teachers/.[334] STEP History and Mission: "The mission of the MIT Teacher Education Program, under the direction of Prof. Eric Klopfer, is twofold. First, we are working to develop a cadre of MIT undergraduates that will become the science and math teachers of tomorrow. Building upon students' unique strengths and deep understanding of science, we believe that we can make a substantial contribution to K-12 education if not in numbers of teachers, then with the quality of teachers that we produce. Second, we are working with in-service teachers to change their practices as we help them bring the "MIT Experience" to their classrooms via new technologies. We develop technologies and curriculum that help students and teachers delve deeper as they explore the cutting edge of math and science. Our particular emphasis is on the research, development, and implementation of new simulations and games for learning."

Coming back to those disempowering ideas, by not fostering a free, inquiring and creative mindset based on science, the trilateral commission established uncritical and passive obedience to authorities as the standard behavior for our schools. They also inserted historical and self-reflection filters in the curriculum that impedes the proper understanding of the American political system (no civic education throughout the system), an effective method of de-politicization. They excluded all foreign policy discussion and justification for all those invasions of other countries in American history books. It was more precisely through those filters, that the intellectual managers of American Society were able to blindfold, pacify and brainwash a significant portion of the newly liberated knowledge society and thereby continue the monopoly of the knowledge power in the private sphere. It wasn't only the commission of Wall Street bankers and lawyers who conspired against the public system; it was also the military executive (the commander and chief), the congress, and the academic and industrial complex. They all colluded in creating a global military empire (a hegemonic monster) that is bankrupting and preventing the democratic system from truly being implemented. This is why the appropriations are now in the Trillions of dollars. Chalmers Johnson explains it best in his book: The Sorrows of Empire: Militarism, Secrecy, and the End of the Republic (The American Empire Project).

Here is a very important summary of his book by the Amazon.com editorial review. "Since September 2001, the United States has "undergone a transformation from republic to empire that may well prove irreversible," writes Chalmers Johnson. Unlike past global powers, however, America has built an empire of bases rather than colonies, creating in the process a government that is obsessed with maintaining absolute military dominance over the world, Johnson claims. The Department of Defense currently lists 725 official U.S. military bases outside of the country and 969 within the 50 states (not to mention numerous secret bases). According to the author, these bases are proof that the "United States prefers to deal with other nations through the use or threat of force rather than negotiations, commerce, or cultural interaction." This rise of American militarism, along with the corresponding layers of bureaucracy and secrecy that are created to circumvent scrutiny, signals a shift in power from the populace to the Pentagon: "A revolution would be required to bring the Pentagon back under democratic control," he writes." In Sorrows of Empire, Johnson discusses the roots of American militarism, the rise and extent of the military-industrial complex, and the close ties between arms industry executives and high-level politicians. He also looks closely at how the military has extended the boundaries of what constitutes national security in order to centralize intelligence agencies under their control and how statesmen have been replaced by career soldiers on the front lines of foreign policy--a shift that naturally increases the frequency with which we go to war. Though his conclusions are sure to be controversial, Johnson is a skilled and experienced historian who backs up his claims with copious research and persuasive arguments. His important book adds much to a debate about the realities and direction of U.S. influence in the world." --Shawn Carkonen [335]

The doctrinal analysis of the military and education system led Noam Chomsky to the conclusion that in the USA, education equals ignorance, intentional ignorance that is. This explains why so many intellectuals in the USA are so complicit with the war crimes (State sponsored terrorism) committed by the Pentagon throughout the world.[336] An Amazon reviewer who is actually a history professor confirmed my own experience with American history with his analysis of a powerful book. "Overthrow: America's Century of Regime Change from Hawaii to Iraq by Stephen Kinzer," is, I think, a necessary and valuable contribution to the study of American history. It's one of those few books that I begin reading and find difficult to put aside. While not exactly a "thriller" in the ordinary sense of a James Bond novel, I found myself continuing to turn page after page, reluctant to take a break, hesitant to stop reading lest I miss something important by forgetting where I left off and, all in all, curious about what was coming next. This was strange; after all, I taught American history for over ten years and have continued to study it ever since I left teaching. But not much of the "stuff" Kinzer is relating. No, the whole idea of so-called "regime change" was never a topic discussed in a history class I taught. For that matter, it was not a topic in any American history course I took in college."[337]

Chomsky's educational statements about the intentional ignorance of the USA indoctrination policy are clearly illustrated in Weiner's assessment of the CIA. Doctrinal ignorance[338] is clearly one of the fundamental reasons why the intellectual managers of the society are subservient to private and military power, instead of the American people. In his Pulitzer winning book: Legacy of Ashes: the History of the CIA author Tim Weiner also gives us an insider view of what has actually happened within the military empire and its intentional ignorance. Again the Amazon.com review gives an excellent summary. "Is the Central Intelligence Agency a bulwark of freedom against dangerous foes, or a malevolent conspiracy to spread American imperialism? A little of both, according to this absorbing study, but, the author concludes, it is mainly a reservoir of incompetence and delusions that serves no one's interests well. Pulitzer Prize–winning New York Times correspondent Weiner musters extensive archival research and interviews with top-ranking insiders, including former CIA chiefs Richard Helms and Stansfield Turner, to present the agency's saga as an exercise in trying to change the world without bothering to understand it. Hypnotized by covert action and pressured by presidents, the CIA, he claims, wasted its resources fomenting coups, assassinations and insurgencies, rigging foreign elections and bribing political leaders, while its rare successes inspired fiascoes like the Bay of Pigs and the Iran-Contra affair. Meanwhile, Weiner contends, its proper function of gathering accurate intelligence languished. With its operations easily penetrated by enemy spies, the CIA was blind to events in adversarial countries like Russia, Cuba and Iraq and tragically wrong about the crucial developments under its purview, from the

Iranian revolution and the fall of communism to the absence of Iraqi WMDs. Many of the misadventures Weiner covers, at times sketchily, are familiar, but his comprehensive survey brings out the persistent problems that plague the agency. The result is a credible and damning indictment of American intelligence policy."[339]

It is not only the CIA or the intellectual managers of the society who are subservient to this military and state capitalist indoctrination policy but also the scientist and engineers, see the dark history of fusion and fission science in: Sun in a Bottle by Charles Seife: The author of Zero looks at the messy history of the struggle to harness fusion energy. Review: When weapons builders detonated the first hydrogen bomb in 1952, they tapped into the vastest source of energy in our solar system--the very same phenomenon that makes the sun shine. Nuclear fusion was a virtually unlimited source of power that became the center of a tragic and comic quest that has left scores of scientists battered and disgraced. For the past half-century, governments and research teams have tried to bottle the sun with lasers, magnets, sound waves, particle beams, and chunks of meta. (The latest venture, a giant, multi-billion-dollar, international fusion project called ITER, is just now getting underway.) Again and again, they have failed, disgracing generations of scientists. Throughout this fascinating journey Charles Seife introduces us to the daring geniuses, villains, and victims of fusion science: the brilliant and tortured Andrei Sakharov; the monomaniacal and Strangelovean Edward Teller; Ronald Richter, the secretive physicist whose lies embarrassed an entire country; and Stanley Pons and Martin Fleischmann, the two chemists behind the greatest scientific fiasco of the past hundred years. Sun in a Bottle is the first major book to trace the story of fusion from its beginnings into the 21st century, of how scientists have gotten burned by trying to harness the power of the sun. About the Author; Charles Seife is the author of Decoding the Universe, Alpha & Omega, and Zero, which won the PEN/Martha Albrand Award for first nonfiction book, and was named a New York Times Notable Book. An Associate Professor of journalism at New York University, he has written for Science magazine, New Scientist, Scientific American, The Economist, Wired, The Sciences, and many other publications.

Sun in a Bottle is intended for an audience who has had no introduction to the subject of nuclear fusion. As such, it lumps three very different subjects into one 200-page account: 1) nuclear weapons history, 2) mainstream fusion research, and 3) fringe-fusion-attempts, and in my opinion only does justice to the latter. Seife's book is very well written, and he is very skilled at explaining scientific concepts to the lay audience. Those with no knowledge of the science will learn something reading the book. Seife's greatest success is in describing the comical and dishonest attempts at fusion performed by the so-called lone wolves. His journalistic style is well suited to tell the strange stories of cold and bubble fusion. In particular, his personal association with the bubble-fusion story made it a fairly gripping account. Even specialists may learn something from these sections. The same journalistic narrative is less effective, however, in casting the complex moral quagmire that was the nuclear weapons program in the 50s. I agree that there are better accounts of this time period, albeit longer (Rhodes "Dark Sun", etc), and Seife dramatizes and simplifies the whole period to a struggle between two men, Oppenheimer and Teller; an engaging narrative, but a historical cheat. The third section, on mainstream fusion, is sparse at best and deceptive at worst. Seife clearly has an opinion/agenda writing this and he is not afraid to persuade us. His arguments are mainly historical in nature, relying on past failures to preclude future discoveries. Again, the lay person will learn something reading about the different experiments, but it is important to remember the bias. In conclusion, Seife tries to do 3 things in one book. If you are only interested in one of the three, look for a more focused account. If you know nothing about nuclear fusion, and want somewhere to start, the book will certainly give you a sweeping tour, though with a strong emphasis on the fringe-figures. Specialists will find themselves cringing far too often. [340]

For a thorough analysis of the indoctrination system in education you can see; Chomsky on Democracy and Education (Social Theory, Education, and Cultural Change) by Noam Chomsky. According to Amazon review "Education stands at the intersection of Noam Chomsky's two lives as scholar and social critic: As a linguist he is keenly interested in how children acquire language, and as a political activist he views the education system as an important lever of social change. Chomsky on Democracy and Education gathers for the first time his impressive range of writings on these subjects, some previously unpublished and not readily available to the general public. Raised in a progressive school where his father was principal, Chomsky outlines a philosophy of education steeped in the liberal tradition of John Dewey, more concerned with cultivating responsible citizens than feeding children facts. The goal of education, Chomsky argues, is to produce free human beings whose values are not accumulation and domination, but rather free association on terms of equality. Spanning issues of language, power, policy and method, this collection includes seminal theoretical works like Language and Freedom, a social analysis of the role of schools and universities in the American polity, and specific critiques of language instruction in America's classrooms today, along with new interviews conducted by Carlos Otero that serve to encapsulate Chomsky's views. Engaging and incisive, Chomsky on Democracy and Education makes accessible the key insights that have earned Chomsky such a committed following."[341]

This military and amoral indoctrination in education policy is the true reason for the "closing of the American mind," and not the lack of study of heroic books as Mr. Blooms so vigorously proclaimed.[342] This indoctrination policy is rooted in the empiricist philosophical tradition that views human beings as empty vessels, empty values and blank slates, through which the ruling business and military class imprints its values. It's also related to the old religious thinking that human being are inherently evil and only God makes them good (the doctrine of original sin). See the powerful essay on: God And The State (Paperback) by Mikhail Aleksandrovich Bakunin; Bakunin's ideas eventually evolved into what became known as anarchism -- the idea that the only way to a just society is through a society where no one rules over another...where all are equals… Bakunin represented in his time the very embodiment of radical revolution, and this book lets the reader get a sense of this. Bakunin's political beliefs rejected governing systems in every name and shape, from the idea of God downwards; and every form of external authority, whether emanating from the will of a sovereign or from universal suffrage. He wrote in his Dieu et l'Etat or God and the State (published posthumously in 1882): "The liberty of man consists solely in this, that he obeys the laws of nature, because he has himself recognized them as such, and not because they have been imposed upon him externally by any foreign will whatsoever, human or divine, collective or individual." Natural laws being thus recognized by every man for himself, Bakunin's reasoning went, an individual could not but obey them,

for they would be the laws also of his own nature; and the need for political organization, administration and legislation would at once disappear… Another Amazon reviewer correctly stated that 'according to Bakunin, the State cannot exist without some form of religious body. Since Anarchism denounces the State, it must necessarily follow that Anarchism also rejects religion." [343] This interdependence of State and religion is the primary reason why there has been massive funding of religious schools (faith based initiatives) in America and the world over.[344] Since the belief system promotes blind faith in its literature (the Bible) and their leaders (the movement conservatives and corporate democrats), it is threaten by the critical and self corrective mode of science. Science education in general is therefore undermined and underfunded except for the militarization of science and space (figure 61) which continues to be heavily funded but the information is kept classified (See Chomsky's video lecture @ MIT).[345]

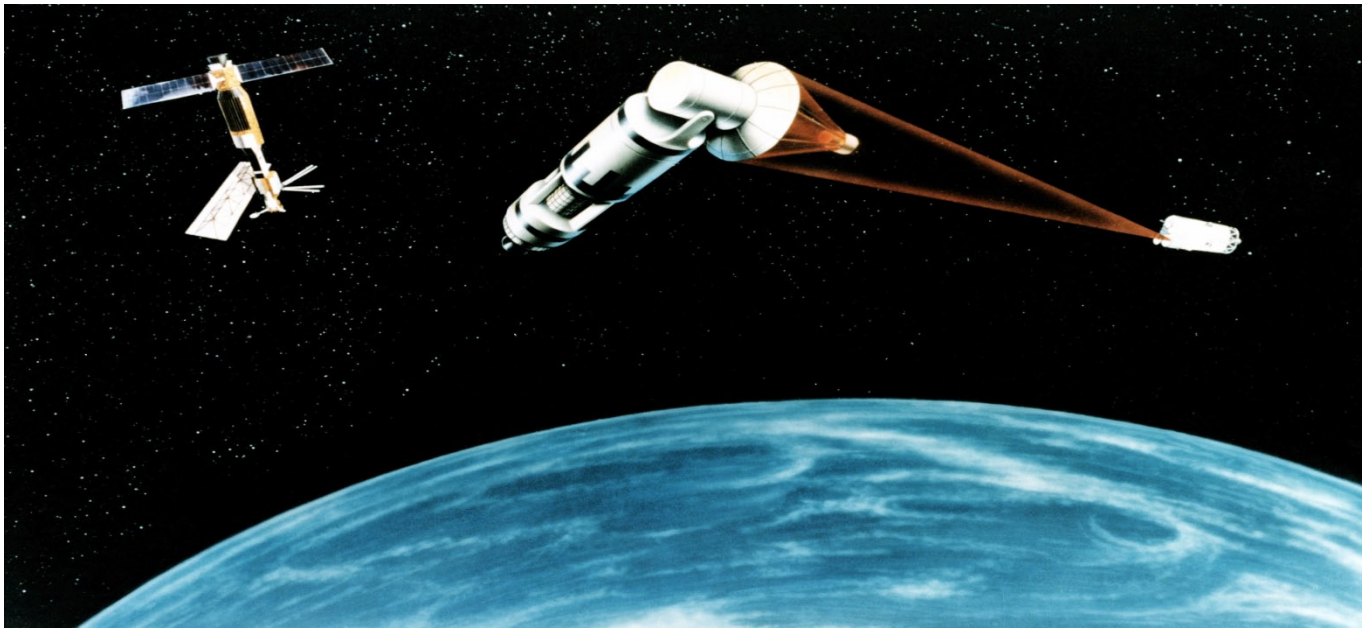

Figure 61. An artist's concept of a Space Laser Satellite Defense System, 1984. (Not any one system specifically, just generalized concept artwork) An early focus of the project was toward a curtain of X-ray lasers powered by nuclear explosions. The curtain was to be deployed using a series of missiles launched from submarines or, later on, satellites, during the critical seconds following a Soviet attack. The satellites would be powered by built-in nuclear warheads--in theory, the energy from the warhead detonation would be used to pump a series of laser emitters in the missiles or satellites in order to produce an impenetrable barrier to incoming warheads. However, on March 26, 1983,[10] the first test, known as the Cabra event, was performed in an underground shaft and resulted in marginally positive readings that could be dismissed as being caused by a faulty detector. Since a nuclear explosion was used as the power source, the detector was destroyed during the experiment and the results therefore could not be confirmed. Technical criticism [11] based upon unclassified calculations suggested that the X-ray laser would be of at best marginal use for missile defense.[12] Such critics often cite the X-ray laser system as being the primary focus of SDI, with its apparent failure being a main reason to oppose the program. However, the laser was never more than one of the many systems being researched for ballistic missile defense.[346] Credit, courtesy of Wikipedia.

This empiricist, religious and militarized value system is one of the reasons why even though New York City public schools tried to raise the averaged math score to 65%, it had to bring it back down to 55% because if not 80% of all the students would have failed. Under the movement conservative leadership, the USA public school system became the worst performing science educator of all the developed nations. "In a 1993 lawsuit, The Campaign for Fiscal Equity v. State of New York, CFE filed a constitutional challenge to New York State's school finance system, claiming that it underfunded New York City's public schools and denied its students their constitutional right to the opportunity to a sound basic education. In 2003, the Court of Appeals, the state's highest court, ruled in favor of CFE and ordered the State to undertake sweeping reforms."[347] The State's highest court… gave the legislature a year to remedy this injustice by reforming the state's education funding system. Governor Pataki and the Senate Republican Majority refused to address the Court order. The impasse on this issue led to a complete breakdown of the legislative process in 2004 and the latest state budget in history. The CFE case has been caught in legislative and judicial battles for more than 10 years. In the latest round of judicial decisions, a three member panel of referees recommended that New York State provide NYC, on an annual basis, with an additional $5.6 billion dollars in operational funds."[348]

The best evidence for how our public schools are underperforming is given in the book: The Shame of the Nation, The restoration of apartheid schooling in America by educator and author Jonathan Kozol. It describes how, in the United States, black and Hispanic students tend to be concentrated in schools where they make up almost the entire student body.[1] Kozol visited nearly 60 public schools in preparation for writing the book. He found that conditions had grown worse for inner-city children in the 50 years since the Supreme Court in the landmark ruling of Brown v. Board of Education dismantled the previous policy of de jure segregated schools and their conceit of "separate but equal". In many cities, wealthier white families continued to leave the city to settle in suburbs, with minorities comprising most of the families left in the public school system.[2] In the book Kozol quotes Gary Orfield of the Harvard Graduate School of Education, who says, "American public schools are now 12 years into the process of continuous resegregation. During the 1990's, the proportion of black students in majority white schools has decreased to a level lower than in any year since 1968."[1][2] [349]

Another good book that clearly outlines the discrepancy between the private and the public system and how the malfeasance is extending even into the private schools is: The Global Achievement Gap: Why Even Our Best Schools Don't Teach the New Survival Skills Our Children Need--And What We Can Do About It by Tony Wagner. Review, About.com "If you want to be on the leading edge of education in our new world, Tony Wagner's "The Global Achievement Gap" is a good place to start." "The Global Achievement Gap is a must read for all policymakers as the Congress continues its debate on how best to reform the No Child Left Behind law…It's time to stop harping on what's wrong with our schools, and instead provide them with the tools that they need to produce competitive, connective, technologically proficient, hopeful young men and women ready to take on the challenges of a global economy and succeed."—U.S. Senator Daniel K. Inouye.

"Tony Wagner takes us deep inside the black box of school curriculum in a way few authors have done. What do we mean by rigor? By 21st century skills? Wagner shows us concretely what thinking skills really are, how current approaches to 'raising standards' cannot get us there, and what will. Everyone concerned with American education should read this book."—Linda Darling-Hammond, Charles E. Ducommun Professor of Education, Stanford University. "Tony Wagner has managed to penetrate the jargon and over-simplified responses to the pervasive underachievement that exists among our students. He has charted an important new direction and given us a way to get there. This book deserves to be powerfully influential."—Mel Levine. "Tony Wagner argues persuasively that old ways of teaching are completely unsuited to new ways of working. The Global Achievement Gap should be grabbed by business leaders to guide a much-needed conversation with educators."—Rosabeth Moss Kanter, Harvard Business School Professor and author of America the Principled and Confidence.

"In The Global Achievement Gap, Tony Wagner offers a thoughtful analysis of where we are in American public education (behind the times), and what we need to do to adapt to the future that is upon us. Drawing upon years of accumulated wisdom as a teacher, principal, trainer, and well-traveled observer of schools, Wagner builds a persuasive case for change in the way we approach schooling, grounded in the question, what does it mean to be an educated person in the 21st century?"—Dr. Richard C. Atkinson, President Emeritus, University of California. "The Global Achievement Gap is thoughtful and inspirational. It describes how, in these changing times, schools too must change if the US is to remain a strong economic and intellectual leader in the world, and it offers creative solutions and examples of success. This book will capture your head, your heart and, I hope, your future actions. This is a VERY important book for anyone who cares about preparing young people for success in a rapidly changing global society. Every school board member, administrator, teacher and parent in the nation should read this book."—Anne L. Bryant, Executive Director, National School Boards Association. "Tony Wagner is not just talking about our schools here—he is talking about the future our nation.

The Global Achievement Gap cuts through the complexity and partisan posing so often associated with this genre. It is a powerful call to action, and a roadmap of how to fundamentally rethink the education of our children. If we ignore it, we do so at great peril."—Keith R. McFarland, author of #1 Wall Street Journal and New York Times Bestseller, The Breakthrough Company: How Everyday Companies Become Extraordinary Performers. "Kudos to Tony Wagner….Many people have been cursing the darkness of our education system, but by breaking down the many dilemmas that students, teachers and parents face as well as examining different approaches that have been successful, Wagner lights a candle for those who want to help, but don't know where to start. Whether we can transition through these exciting and perilous times will depend upon the culture we leave our young people. Tony Wagner has provided a map."—John Abele, Founding Chairman, Boston Scientific, Board Chair, FIRST. "This important book is a wake-up call for America. For over fifty years, our schools have stayed the same, while the world has changed dramatically. Students memorize academic content, and study for standardized tests, but they never learn how to think, solve problems, or be creative. Wagner's stories about the few remarkable schools that are transforming classroom instruction and pointing the way to the future are compelling. Every parent, teacher, politician, and executive should read this book."—Keith Sawyer, author of Group Genius. "In this persuasive book, Tony Wagner delineates what skills are needed in a globalized era, why most American schools can't nurture them, and how today's schools could be transformed to cultivate tomorrow's skills."—Howard Gardner, author of Five Minds for the Future. EDUCATED QUEST "If I had the money, I would buy a copy of this book for every governor, congressman and senator; this book presents a far better direction for education politics than the current thoughts from Washington…The Global Achievement Gap is well-reasoned and well-written…If you're a parent who is serious about your child's education and course content, buy this book and use the Survival Skills as your guide." Harvard Crimson "…Wagner's book raises many important questions about both the state and purpose of secondary education in America."

In contradistinction to the empiricist, the religious and the military, the rational libertarian socialist tradition recognizes a human being as intrinsically valuable. In the rational model of human nature not only is the human intrinsically valuable but he is also genetically endowed with information, knowledge and wisdom.[350] The rational tradition goes back to Plato when he recognized that knowledge was preexistent in human beings. He illustrated this notion of innate knowledge with a story about a slave boy who demonstrated that he already had mathematical knowledge of a triangle inside his head. He proved it by soliciting and questioning the boy who had no math education but was able to recognize the properties of the Pythagorean triangle.[351] This notion of genetically endowed knowledge inside the human was further developed during the Enlightenment with Leibnitz and Descartes who purged Plato's metaphysical notion of the preexistence of knowledge because he attributed it to some other life (transmigration of souls) and so they adapted or upgraded the notion to a physical understanding, that the knowledge is within the biological structure itself, our brains, and our nervous system.

This endogenous notion of knowledge is in full development today thanks to the human genome project (figure 62) and the bio-linguistic and cognition structures that Chomsky (figure 63)[352] has so well established in the second half of 20th century. With the recognition of the rational notion of education as a process of educing or drawing out the full info-potential that is embedded in the individual, comes a deep respect and wonderful admiration for the human being and its full flowering. The educational process is

now seen as a gardening process in which the teacher or facilitator acts in the role of a gardener who plants a seed in the garden. His or her responsibility is to provide a proper environment for the seed to grow healthfully with plenty of sunlight, water and good soil. Metaphorically speaking, today the good soil is the internet and the World Wide Web 3.0 for the mind (figure 64). The water is the highest quality scientific content coming out of MIT and the best schools, and the sunlight is the laser light that flows, animates and powers the information networks. So with the advent of the internet, a public project of the 1960's, knowledge workers have produced a global ecosystem for the mind.

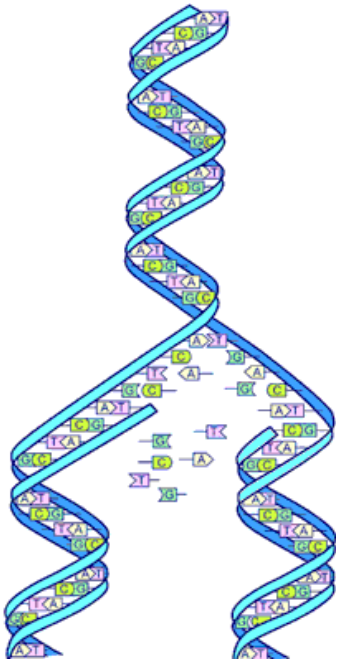

Figure 62.The Human Genome Project (HGP) was an international scientific research project with a primary goal to determine the sequence of chemical base pairs which make up DNA and to identify the approximately 25,000 genes of the human genome from both a physical and functional standpoint. Courtesy of Wikipedia.[353]

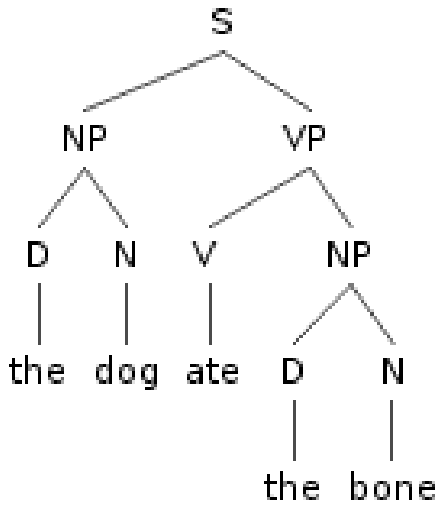

Figure 63.The resulting sentence could be: The dog ate the bone. Such a tree diagram is also called a phrase marker. They can be represented more conveniently in text form, (though the result is less easy to read); in this format the above sentence would be rendered as:[S [NP [D The] [N dog]] [VP [V ate] [NP [D the] [N bone]]]]. Essentially, the tree model works something like this example, in which S is a sentence, D is a determiner, N a noun, V a verb, NP a noun phrase and VP a verb phrase: Chomsky has argued that phrase structure grammars are also inadequate for describing natural languages, and has formulated the more complex system of transformational grammar.[1]In theoretical linguistics, generative grammar refers to a particular approach to the study of syntax. A generative grammar of a language attempts to give a set of rules that will correctly predict which combinations of words will form grammatical sentences. In most approaches to generative grammar, the rules will also predict the morphology of a sentence. Generative grammar originates in the work of Noam Chomsky, beginning in the late 1950s. (Early versions of Chomsky's theory were called transformational grammar, and this term is still used as a collective term that includes his subsequent theories.) There are a number of competing versions of generative grammar currently practiced within linguistics. Chomsky's current theory is known as the Minimalist Program. Other prominent theories include or have included Head-driven phrase structure grammar, Lexical functional grammar, Categorial grammar, Relational grammar, and Tree-adjoining.

The Internet is a worldwide, publicly accessible series of interconnected computer networks that transmit data by packet switching using the standard Internet Protocol (IP). It is a "network of networks" that consists of millions of smaller domestic, academic, business, and government networks, which together carry various information and services, such as electronic mail, online chat, file transfer, and the interlinked web pages and other resources of the World Wide Web (WWW). The World Wide Web (commonly shortened to the Web) is a system of interlinked hypertext documents accessed via the Internet. With a Web browser, a user views Web pages that may contain text, images, videos, and other multimedia and navigates between them using hyperlinks. The World Wide Web was created in 1989 by Sir Tim Berners-Lee, working at CERN in Geneva, Switzerland. Since then, Berners-Lee has played an active role in guiding the development of Web standards (such as the markup languages in which Web pages are composed), and in recent years has advocated his vision of a Semantic Web. Robert Cailliau, also at CERN, was an early evangelist for the project.

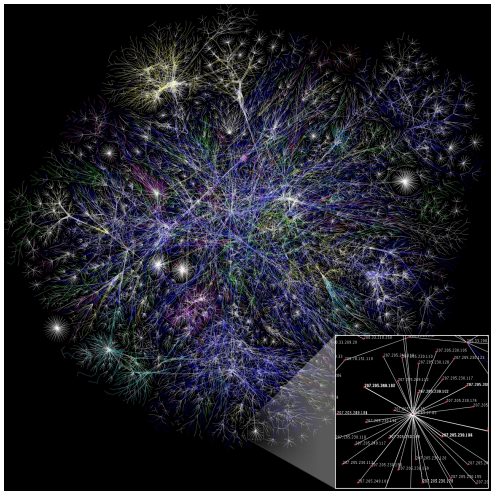

Figure 64.Visualization of the various routes through a portion of the Internet backbone. Each line is drawn between two nodes, representing two IP addresses. This is a small look at the backbone of the Internet. The Internet backbone refers to the main "trunk" connections of the Internet. It is made up of a large collection of interconnected commercial, government, academic and other high-capacity data routes and core routers that carry data across the countries, continents and oceans of the world. Part of the extreme resilience of the Internet is due to a high level of redundancy in the Internet backbone and the fact that the Internet Protocol routing decisions are made and updated in real-time during use.[354]

Figure 65.This is an atlas of maps and graphic representations of the geographies of the new electronic territories of the Internet, the World-Wide Web and other emerging Cyberspaces. These maps of Cyberspaces - cybermaps - help us visualize and comprehend the new digital landscapes beyond our computer screen, in the wires of the global communications networks and vast online information resources. The cybermaps, like maps of the real-world, help us navigate the new information landscapes, as well being objects of aesthetic interest. They have been created by 'cyber-explorers' of many different disciplines, and from all corners of the world.[355]

With the advent of MIT's Open Course Ware online we have the greatest scientific content freely available to everybody worldwide and with the laser as the infrastructure illuminating the optical networks, we have the equality of condition that is necessary for the full flowering of the democratic empowerment of mankind.[356] So just like the seed is artfully implanted in the fertile earth for healthy growth, we as laser informed learners, implant our minds on the internet ecosystem and water that seed with the highest scientific, philosophical and artistic content from our best universities. We illuminate our minds with the laser's coherent powers and energize the foundation of the internet. Through it we will intellectually flower and actualize our fullest potential. And just as plant life requires sunlight to actualize and grow its potential, the same way our minds are now receiving laser light to coherently develop our

intelligence. Just as sunlight empowers most of life on earth, the laser light empowers the whole internet ecosystem.

Going deeper into the laser educator's metaphor we now turn towards the seed, its properties and its identity. The equivalent metaphor here is the neuron in our brain. This is the seed that is implanted on the internet ecology or soil. The neuron and its genetic info potential is now embedded in the optical network (virtual retinal display) through which it grows and develops its synaptic connections in a treelike form. To visualize this idea go to "NEURON a simulation environment for modeling individual neurons and networks of neurons. It provides tools for conveniently building, managing, and using models in a way that is numerically sound and computationally efficient. It is particularly well-suited to problems that are closely linked to experimental data, especially those that involve cells with complex anatomical and biophysical properties. NEURON is distributed free of charge from http://www.neuron.yale.edu/. It runs on all popular hardware platforms under MSWin (98 or later), UNIX, Linux, and OS X, and on parallel hardware including Beowulf clusters, the IBM Blue Gene, and the Cray XT3."[357]

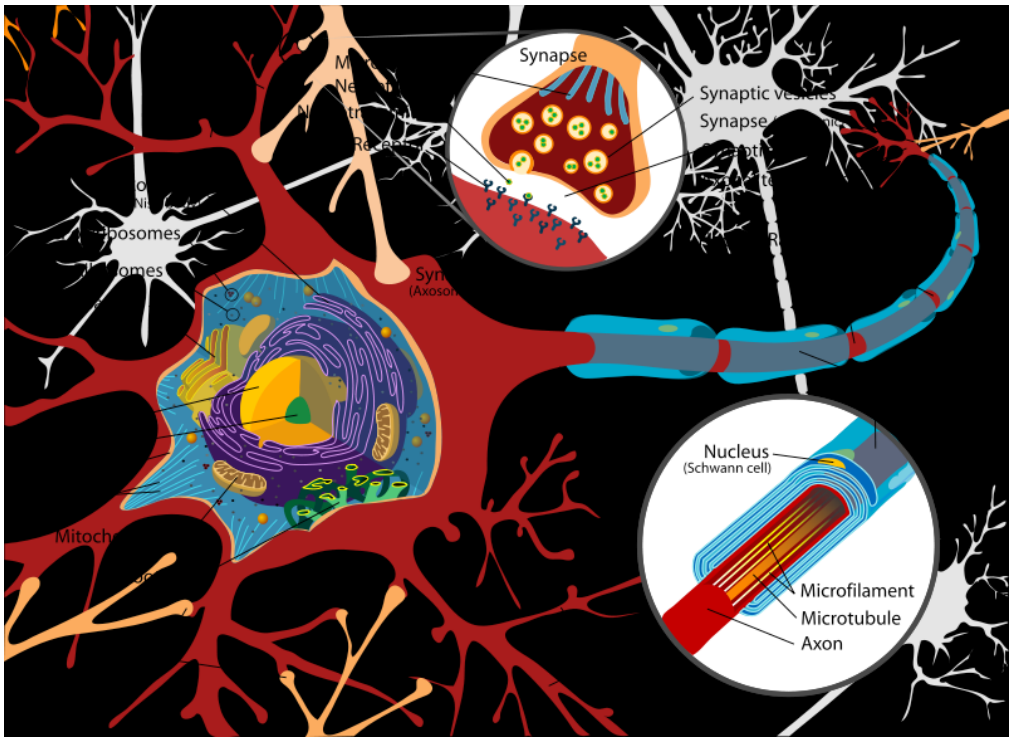

Figure 66. Diagram of a typical myelinated vertebrate neuron. Credit, courtesy of Wikipedia.

Neurons are highly specialized for the processing and transmission of cellular signals. Given the diversity of functions performed by neurons in different parts of the nervous system, there is, as expected, a wide variety in the shape, size, and electrochemical properties of neurons. For instance, the soma of a neuron can vary from 4 to 100 micrometers in diameter.[10] The soma is the central part of the neuron. It contains the nucleus of the cell, and therefore is where most protein synthesis occurs. The nucleus ranges from 3 to 18 micrometers in diameter[11]The dendrites of a neuron are cellular extensions with many branches, and metaphorically this overall shape and structure is referred to as a dendritic tree. This is where the majority of input to the neuron occurs. Information outflow (i.e. from dendrites to other neurons) can also occur, but not across chemical synapses; there, the backflow of a nerve impulse is inhibited by the fact that an axon does not possess chemoreceptors and dendrites cannot secrete neurotransmitter chemicals.

This unidirectionality of a chemical synapse explains why nerve impulses are conducted only in one direction.

The axon is a finer, cable-like projection which can extend tens, hundreds, or even tens of thousands of times the diameter of the soma in length. The axon carries nerve signals away from the soma (and also carries some types of information back to it). Many neurons have only one axon, but this axon may - and usually will - undergo extensive branching, enabling communication with many target cells. The part of the axon where it emerges from the soma is called the axon hillock. Besides being an anatomical structure, the axon hillock is also the part of the neuron that has the greatest density of voltage-dependent sodium channels. This makes it the most easily-excited part of the neuron and the spike initiation zone for the axon: in neurological terms it has the most negative hyperpolarized action potential threshold. While the axon and axon hillock are generally involved in information outflow, this region can also receive input from other neurons.

The axon terminal contains synapses, specialized structures where neurotransmitter chemicals are released in order to communicate with target neurons.[358] The neuron is the fundamental cell in our brain that is in charge of executing our mental potential or the associations of ideas that flow through its structure. We have over 100 billion of these specialized networks of cells in our brains, which execute every major function in our body for communication, learning and growing our intelligence. These neurons grow and extend their capacity to function in our brain through synaptic nerve connection. It is often said that the only part of our

body that never ceases to grow is our brain. It is precisely through its neuronal connections or synaptic connections that our brains branch out and connect and there is no limit to the amount of associative connections that can be established. The connections in our brains can run into the trillions and the more we learn and the more we understand the more we grow. The more info that flows coherently through these channels or networks, the more our mental capacity or potential grows. This synaptic growth is the fundamental reason why the educator's major mission is to extend the network's capability. This is where the advancement of knowledge plays a fundamental role in the continuous development of our mental capacity. So our mission is to activate by laser illumination the neuronal-networks within our visual, audio and kinesthetic sense. We connect them to a healthy, vibrant and positive educational environment or internet eco-system in which they can flourish and express their fullest potential. Even though our primary responsibility is to cultivate and harness the full development of our own personal neuronal-network or global brain it is now also our responsibility to socially interact our healthy brains with the entire human family that is now connected through the internet. On the internet we now have the opportunity to connect with over a billion other brains. The establishment of a coherent connection with over a billion people's brains online will now increase the global brain capacity and through it, we can harness it for a higher purpose. This is the primary mission that has been established at the MIT Center for Collective Intelligence.[359] The MIT social network of coherent brains will be able to solve all the major problems that humanity is now facing. The ultimate result of this laser focused mission will be the full development or the emergence of a coherent global brain that can act in harmony to help the entire human family.

Going back to the metaphor of the laser as the sunlight for our mind, it is important to realize that the property of the laser as directed mental energy or as focused and concentrated harmonious wave patterns is rapididly becoming the main energy source for the internet. Why did we choose the laser as our energy platform for the development of our brain capacity? There are a number of reasons, one of which is the property of the laser itself. LASER is an acronym for light amplification by stimulated emission of radiation. The fundamental quantum law that Einstein uncovered called stimulated emission of radiation is actually the third property of the principle of light, after absorption and emission. In his 1916 paper on the Quantum Theory of Light, Einstein showed that light is the direct result of photons released by electrons or emission of light that we see in an illuminated landscape like the sun, a light bulb or candle. The phenomenon of light is the result of atomic transitions in which electrons fall from a high state to a low state near the nucleus. This descent of the orbit of electrons from high to low is what results as an emission. When electrons flow from a low state to a higher state or from the nucleus to the outward shells of their orbit they absorb energy. These properties are spontaneously released as electromagnetic energy when they go from high to low states. The waves that are released as light are called electron wave functions by wave theorist and photons by particle theorist. When electrons spontaneously fall from high to low orbit they release an incoherent (disordered) electromagnetic wave pattern that we know as light. Conversely, when the atomic structure of the electrons flow from a low to a high orbit, the electromagnetic waves or signals are absorbed (attenuated). Then there is that third property that Einstein uncovered in the natural process of light emission and absorption, which is stimulated emission of radiation. What that means is that, when the electrons are in the higher state they can be continuously stimulated at that level by an external radiation source (a flash lamp) that can sustain it in that orbit. When that orbit is sustained at the high level, a new stream of coherent (ordered) electromagnetic wave pattern is released.

Figure 67. A Frequency Addition Source of Optical Radiation (FASOR) used at the Starfire Optical Range on Kirtland Air Force Base, New Mexico—is used with deformable optics to help eliminate atmospheric distortions when gathering images of objects in space."Starfire Optical Range LIDAR (Light Detection and Ranging) laser seen here is actually two solid state IR lasers, 1.064 and 1.319 microns that are frequency summed in LBO within a doubly resonant cavity. The orange beam is observed due to the intense laser light scattering off particles in the air. In general, laser light travelling through a vacuum cannot be seen unless aimed directly towards the observer. Courtesy of Wikipedia.[360]

The spontaneous release means that the waves of light are dispersed, diffused and out of phase, this is what we see when we turn on a flashlight or most light sources. The light diffuses within a few feet and then it disappears. When it disappears it is absorbed by the particles in the atmosphere but because of the dispersion it doesn't reach far. In contrast, laser light is the result of induced electromagnetic wave beams that are coherent because the wave patterns are connected, harmonious and in phase, they are essentially

all working together. Because the wave pattern does not vary, the laser beam is not diffused so you can literally hit a dime on the moon or anywhere your target is set. In fact, when the astronauts went to the moon in 1969 they placed a mirror up on the moon (see figure 55 and 56 below). The reason for these experiments is that the scientists wanted to measure the exact distances between the moon and the earth. All we had previous to the astronauts going to the moon were estimates of the distances given by the ancient Greek astronomers and more modern surveying but there was no exact measurement. We finally established the exact measurement when the astronauts placed a mirror on the Moon and we were able to shoot a laser beam right into the mirror and that beam reflected its signal back to earth. As you can see the result of Einstein's law of stimulated emission radiation is a coherent electron wave pattern. Epigenetically when this fundamental property of light is coupled to the neurons in your brain it will unleash and actualize the potential that is inherent in our genetic info-structure. A clear distinction between the power of coherency in nature and incoherency can be seen in the outgrowth of a garden when we have natural sunlight which is actually incoherently giving free reign to the development of weeds in the garden. The weeds illustrate how the spontaneous wave patterns can be very disordered and how they dominate the ecosystem in a way that destroys the order and beauty of the garden. When these weeds are left to spontaneous growth, they will overtake and outgrow all the other plant functions.

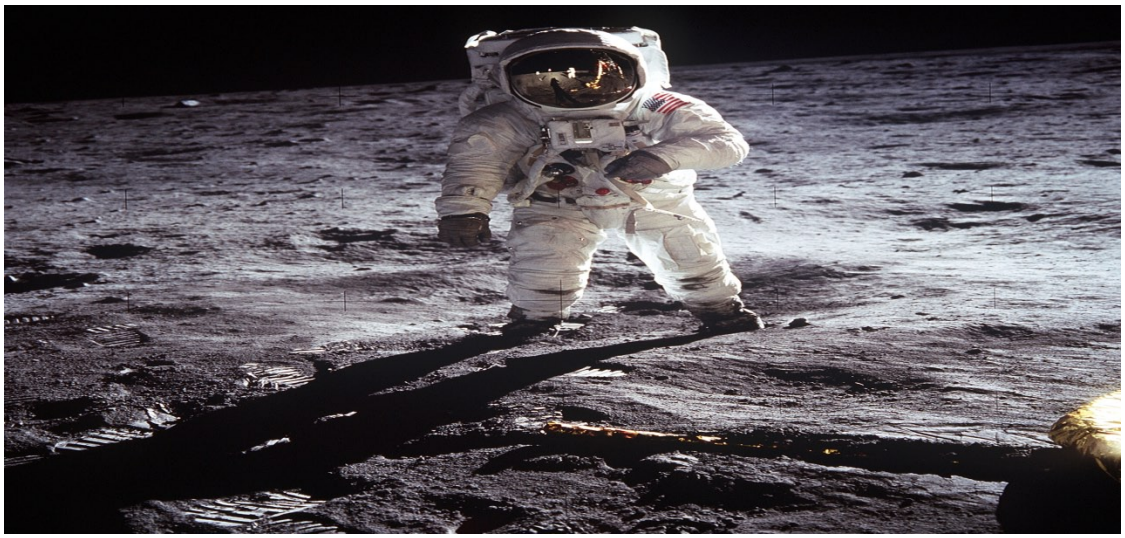

Figure 68. Astronaut Buzz Aldrin photographed by Neil Armstrong during the first moon landing on 20 July 1969. The Moon (Latin: Luna) is Earth's only natural satellite and the fifth largest natural satellite in the Solar System.The distance continually changes for a number of reasons, but averages about 384,467 kilometers (238,897 miles).Credit: courtesy of Wikipedia.[361]

On the contrary with the coherent input of the Gardener you can cultivate a natural landscape in which every plant plays a major function within the harmonious whole. With incoherent outgrowth a weed overtakes all the other functions of the eco-system and impedes their natural fulfillment. You can also see Incoherency on the animal plane with the spontaneous development of cellular disordered growth in the form of a cancer. The disordered growth of a cell without a coherent function within the organism overtakes the natural functions of all other organs or tissues and completely destroys the body. Politically a similar outcome is seen with the privatization (capitalism) of the knowledge economy (incoherent policies) where a few business elites (SuperClass) overtake most of the wealth of the nation and the world over, while the vast majority dies in poverty.[362] This is the result of incoherent social outgrowth and development; it is the result of incoherent light and incoherent forces in nature: chaotic, disordered wave patterns that give free reign to destruction.

Figure 69. The Lunar Laser Ranging Experiment from the Apollo 11 mission. Lunar Laser Ranging Experiment measures the distance between the Earth and the Moon using laser ranging. Lasers on Earth are aimed at retroreflectors previously planted on the Moon and the time delay for the reflected light to return is determined. The distance has been measured repeatedly over a period of more than 35 years. The experiment was first made possible by a retroreflector array installed on July 21, 1969, by the crew of the Apollo 11. Two more retroreflector arrays left by the Apollo 14 and Apollo 15 missions have contributed to the experiment.[363] Credit: courtesy of Wikipedia.

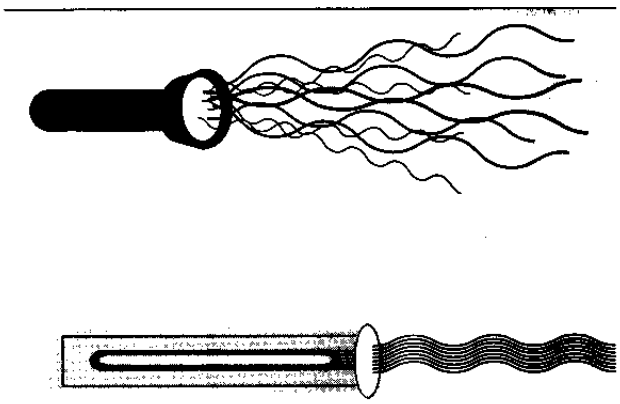

Figure 70. Flashlight (above) radiates incoherent disordered light waves. Laser Pointer (below) radiates coherent ordered light waves.

On the contrary, the laser gives us the capacity to harness the power of coherency in nature (LaserFusion). This is what allows for life to grow harmoniously integrated in its multi-faceted functions. It is precisely for this fundamental reason that I have chosen the laser as the foundation platform to engage the neurons in your brain and to empower them with this unique energy source for its growth. Energy is the capacity for work; energy is what animates the cells to be able to perform their task. With the laser we are able to coherently energize the cellular, plant and social functions of the eco-system so that we can actualize its full potential. The global internet economy is now the main vehicle for the transmission of this coherent power. Incoherent light is to coherent light what the oil/coal based economy is to the LaserFusion based economy. I firmly believe that with LaserFusion power we can transduce the American hegemonic empire based on scarcity, war, coercion and ignorance into an economy based on abundance, peace, freedom and knowledge, the ORBE.

Because we are also living in transition from an age of incoherent diffusion and disinformation, coming from corporate programming of television, radio, newspapers, and the web blogs, we have a major responsibility to be vigilant about the knowing-doing gap that is increasingly disabling and misdirecting today's world. This is where you as a Laser Informed learner eliminate distraction and focus your mind. You can now follow through and discipline yourself to target a particular or global field of knowledge. To accomplish your goals you narrow the direction and focus so that you can convert the information that is specific to your knowledge area into consistent moral action. Your persistent and holistic practice in that field of expertise will give you wisdom. My philosophy or love of Wisdom is connected to that embedded moral notion of making knowledge practice a realization of true value, creating through it a new value by applying the moral sense to the understanding that knowledge has given us. The scientific realization of wisdom and knowledge and the conversion of information into its knowledge praxis will enable us to contribute with the best of our ability to the well being of the planet as a whole.

Part 2. Einsteinian Laser Intelligence for Visualization and Realization of LaserFusion and Geothermal Power for the ORBE

2.4: The Ruby Laser/Maser, NIF, LIGO and LISA

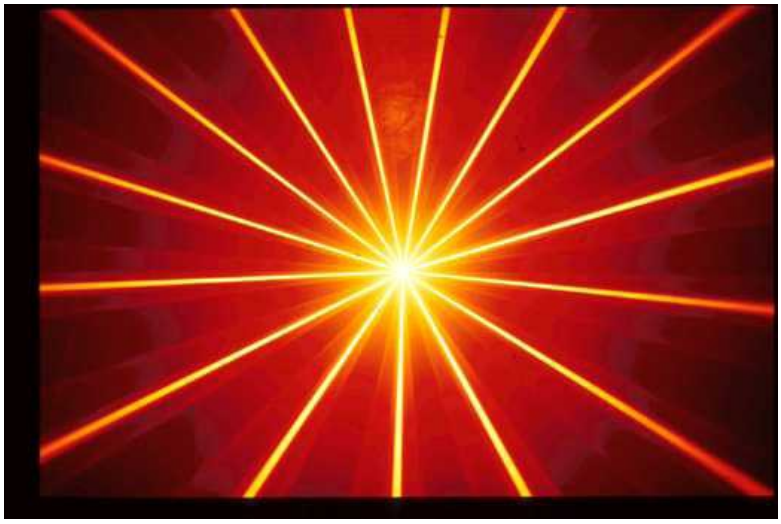

Figure 71.The time has come for humanity to acknowledge, Theodore Maiman's Laser Informed declaration; "LET THERE BE 'COHERENT' LIGHT." Credit: courtesy of Laserium.[364]

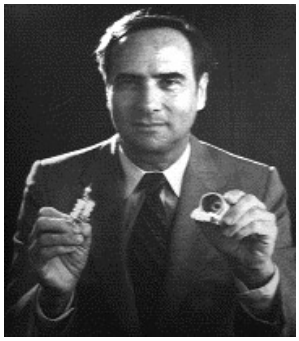

Figure 72. "Maiman's breakthrough with the pulsed ruby laser opened the floodgates. Through the 1960s and 1970s, right up to the present day, scientists and engineers all around the world have produced thousands of different types of Lasers, using all sorts of materials as the "lasing" medium. Laser action has been produced from solids, such as the original ruby crystal, from gases, liquids, and semiconductor very much like the chips used in computers, and even ordinary air." Credit: courtesy of Laurence Livermore Laboratory.[365]

In its short half century history since its birth, the laser has penetrated all major industries and is now informing the world over.[366] It is now well-positioned to inform our personal life. Of the three biographies about and by the inventors (along with Charles Town and Gordon Gould) of the Laser, Maiman's version is the only one that gives full credit to Einstein's fatherhood. "It was Albert Einstein in 1916 that laid the foundation and conceived the basic underlying principles on which lasers are based. He formulated and explained the relations that govern the way that atoms and molecules absorb and emit radiation. He introduced a concept key to laser operation, that of stimulated emission of radiation. That is where the ser in laser comes from… In his famous 1916 treatise on radiation, Einstein came up with a new concept. He showed that atoms already in an excited state could lose their energy by another process, other than and in addition to, spontaneous emission of radiation.

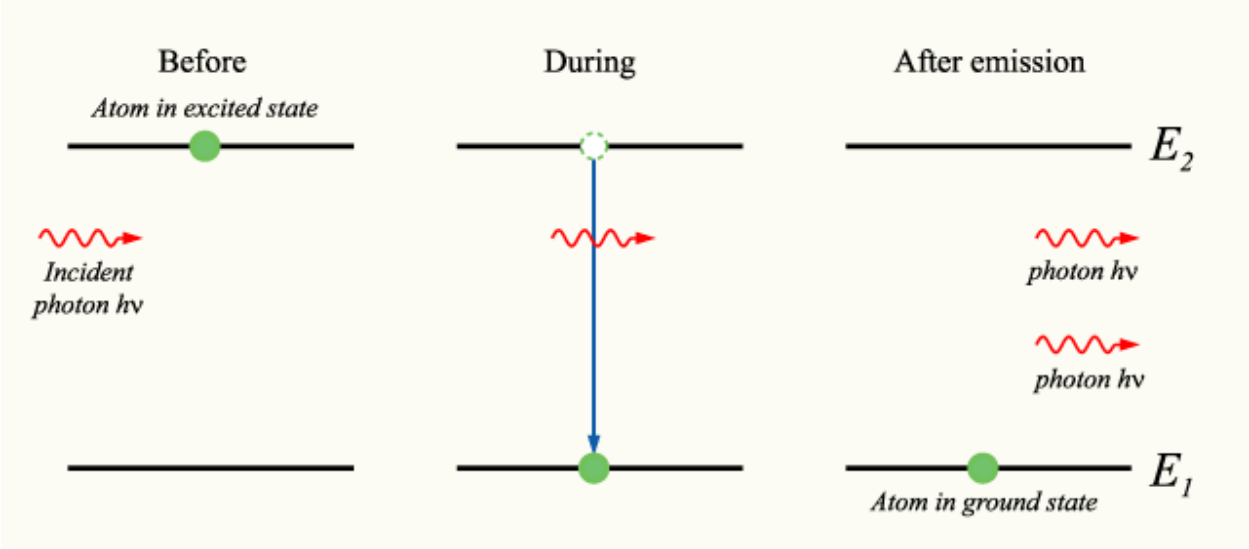

Figure 73. In optics, stimulated emission is the process by which, when perturbed by a photon, matter may lose energy resulting in the creation of another photon. The perturbing photon is not destroyed in the process (cf. absorption), and the second photon is created with the same phase, frequency, polarization, and direction of travel as the original. Stimulated emission is really a quantum mechanical phenomenon but it can be understood in terms of a "classical" field and a quantum mechanical atom. The process can be thought of as "optical amplification" and it forms the basis of both the laser and maser. http://en.wikipedia.org/wiki/Stimulated_emission_of_radiation.

He postulated that a photon that has the same energy that the atom has stored in its excited level could interact with this atom and induce, or stimulate, it to radiate its stored energy in the form of another photon. He called this new process stimulated emission. The outgoing stimulated photon will have the same energy and travel in the same direction as, that of the stimulating photon. The quantum theory analysis of the process shows that not only is the frequency of the electromagnetic radiation associated with the outgoing photon at the same frequency of the stimulating photon, but also the radiation waves are in step with each other. Stimulated emission of radiation is, therefore, coherent." [367] The following section is a compilation and illustration of a few Lasers generated from the power of the first Ruby Laser in the National Ignition Facility (NIF) at Laurence Livermore Laboratory and the Maser illustrated by Wikipedia Followed by the Laser Interferometer Gravity-Wave Observatory (LIGO) and Laser Interferometer Space Antenna (LISA) by NASA websites. The following is a short list and description of authors and books that illuminated my understanding of the laser informed world. The Laser Odyssey by Theodore Maiman @ http://en.wikipedia.org/wiki/Theodore_Harold_Maiman.

Biography

Theodore Harold "Ted" Maiman (July 11, 1927 - May 5, 2007) was an American physicist who made the first working laser. [1] Maiman received the Japan Prize in 1987. He was the author of a book titled The Laser Odyssey". Theodore Harold Maiman developed, demonstrated and patented the world's first laser in 1960. Maiman was born in Los Angeles, California, where in his teens, he earned college money by repairing electrical appliances and radios [2] He attended the University of Colorado and received a B.S. in engineering physics in 1949 then went on to do graduate work at Stanford University, where he received an M.S. in electrical engineering in 1951 and a Ph.D. in physics in 1955. His doctoral thesis in experimental physics, taken under the direction of Willis Lamb, involved detailed microwave-optical measurements of fine structure splittings in excited helium atoms. Maiman's laser, based on a synthetic ruby crystal grown by Dr. Ralph L. Hutcheson, was first operated on 16 May 1960 at Hughes Research Laboratories in Malibu, California.

After leaving Hughes, Maiman joined Quantatron where he was in charge of the laser activities. In 1962, Maiman became president of the newly formed Korad Corporation, a wholly owned subsidiary of Union Carbide. Union Carbide bought the laser assets owned by Quantatron. Korad was devoted to the research, development, and manufacture of lasers. All minority owned stock of Korad Corporation was exchanged for Union Carbide stock during the first five years. Not wishing to continue working for Union Carbide, he formed Maiman Associates in 1968. Due to his work on the laser, he was twice nominated for a Nobel Prize and was given membership in both the National Academies of Science and Engineering.[3] He received the Oliver E. Buckley Prize in 1966. He was the recipient of the 1983/84 Wolf Prize in Physics, and was inducted into the National Inventors Hall of Fame that same year. Besides, he received F&J. Hertz and Japan Prizes. Japan Prize is considered equivalent to Nobel Prize. Many world universities awarded him Honorary Degrees. The last Honorary Degree he received in 2002 from Simon Fraser University, Vancouver, Canada. Maiman died from systemic mastocytosis on May 5, 2007 in Vancouver, Canada, where he lived with his wife.[4]

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3. ^ Douglas Martin (11 May 2007). "Maiman built world's first laser", *The New York Times*.
4. ^ Douglas, Martin (May 11, 2007). Theodore Maiman, 79, Dies; Demonstrated First Laser *New York Times*

External links

Theodore H. Maiman via IEEE Global History Network

Charles Hard Townes (born July 28, 1915) is an American Nobel Prize-winning physicist and educator. Townes is known for his work on the theory and application of the maser, on which he got the fundamental patent, and other work in quantum electronics connected with both maser and laser devices. He received the Nobel Prize in Physics in 1964.

Biography

Townes was born in Greenville, South Carolina, on July 28, 1915, the son of Henry Keith Townes, an attorney, and Ellen (Hard) Townes. He attended the Greenville public schools and then Furman University in Greenville, where he completed the requirements for the Bachelor of Science degree in Physics and the Bachelor of Arts degree in Modern Languages, graduating summa cum laude in 1935, at the age of 19. Physics had fascinated him since his first course in the subject during his sophomore year in college because of its "beautifully logical structure". He was also interested in natural history while at Furman, serving as curator of the museum, and working during the summers as collector for Furman's biology camp. In addition, he was busy with other activities, including the swimming team, the college newspaper and the football band. Townes completed work for the Master of Arts degree in Physics at Duke University in 1936, and then entered graduate school at the California Institute of Technology, where he received the Ph.D. degree in 1939 with a thesis on isotope separation and nuclear spins.

A member of the technical staff of Bell Telephone Laboratories from 1933 to 1947, Townes worked extensively during World War II in designing radar bombing systems and has a number of patents in related technology. From this he turned his attention to applying the microwave technique of wartime radar research to spectroscopy, which he foresaw as providing a powerful new tool for the study of the structure of atoms and molecules and as a potential new basis for controlling electromagnetic waves. At Columbia University, where he was appointed to the faculty in 1948, he continued research in microwave physics, particularly studying the interactions between microwaves and molecules, and using microwave spectra for the study of the structure of molecules, atoms, and nuclei. In 1951, Townes conceived the idea of the maser, and a few months later he and his associates began working on a device using ammonia gas as the active medium. In early 1954, the first amplification and generation of electromagnetic waves by stimulated emission were obtained. Townes and his students coined the word "maser" for this device, which is an acronym for microwave amplification by stimulated emission of radiation. In 1958, Townes and his brother-in-law, Dr. Arthur Leonard Schawlow, for some time a professor at Stanford University but now deceased, showed theoretically that masers could be made to operate in the optical and infrared region and proposed how this could be accomplished in particular systems. This work resulted in their joint paper on optical and infrared masers, or lasers (light amplification by stimulated emission of radiation). Other research has been in the fields of nonlinear optics, radio astronomy, and infrared astronomy. He and his assistants detected the first complex molecules in interstellar space and first measured the mass of the black hole in the center of our galaxy.

Having joined the faculty at Columbia University as Associate Professor of Physics in 1948, Townes was appointed Professor in 1950. He served as Executive Director of the Columbia Radiation Laboratory from 1950 to 1952 and was Chairman of the Physics Department from 1952 to 1955. From 1959 to 1961, he was on leave of absence from Columbia University to serve as Vice President and Director of Research of the Institute for Defense Analyses in Washington, D.C., a nonprofit organization which advised the U.S. government and was operated by eleven universities. In 1961, Townes was appointed Provost and Professor of Physics at the Massachusetts Institute of Technology (M.I.T). As Provost he shared with the President responsibility for general supervision of the educational and research programs of the Institute. In 1966, he became Institute Professor at M.I.T., and later in the same year resigned from the position of Provost in order to return to more intensive research, particularly in the fields of quantum electronics and astronomy. He was appointed University Professor at the University of California in 1967. In this position Townes is participating in teaching, research, and other activities on several campuses of the University, although he is located at the Berkeley campus.

During 1955 and 1956, Townes was a Guggenheim Fellow and a Fulbright Lecturer, first at the University of Paris and then at the University of Tokyo. He was National Lecturer for Sigma Xi and also taught during summer sessions at the University of Michigan and at the Enrico Fermi International School of Physics in Italy, serving as Director for a session in 1963 on coherent light. In the fall of 1963, he was Scott Lecture at the University of Toronto. More recently (2002-2003) he has been the Karl Schwarzschild Lecturer in Germany and the Birla Lecturer and Schroedinger Lecturer in India. In addition to the Nobel Prize, Townes has received the Templeton Prize, for contributions to the understanding of religion, and a number of other prizes as well as 27 honorary degrees from various universities. Townes has served on a number of scientific committees advising governmental agencies and has been active

in professional societies. This includes being a member, and vice chairman, of the Science Advisory Committee to the President of the U.S., Chairman of the Advisory Committee for the first human landing on the moon, and chairman of the Defense Department's Committee on the MX missile. He also served on the boards of General Motors and of the Perkins Elmer Corporations. Townes and his wife (the former Frances H. Brown; they married in 1941) live in Berkeley, California. They have four daughters, Linda Rosenwein, Ellen Anderson, Carla Kessler, and Holly Townes.

Research

Charlie Townes was the lead researcher in the construction of the Infrared Spatial Interferometer, the first astronomical interferometer to operate in the mid-infrared. He continues researching into astrophysics and astronomy at the University of California, Berkeley. With Arthur Leonard Schawlow, he wrote the book Microwave Spectroscopy, published in 1955. During his time at Bell Labs Townes was asked to help with the development of a new radar system for aircraft in World War II. He never served in the military, but felt he was helping his country from within the lab. Townes and his team were successful in creating more accurate and precise radar systems, but none of them were ever mass produced by the military. Some of the new systems developed were used as prototypes in early B-52 Bombers. After the war, Townes continued to work at Bell Labs, creating new radar by experimenting with different radio wavelengths. Moving from Bell Labs in 1948, to the physics department of Columbia University allowed Townes to return to experimental physics and away from the applications of physics. At Columbia, his research was still partially funded by the US Navy's desire for even smaller radar. At Bell Labs Townes helped develop a radar system with a 1.25 centimeter wavelength. After moving to Columbia, the military wanted radar systems with wavelengths only a few millimeters. The shortening of the wavelength led Townes and his colleagues to focus on microwave research. In 1951, the idea of the maser was proposed to Townes' superiors. After three years and many experiments, Townes and Jim Gordon created a working maser.

Awards

Townes has been widely recognized for his scientific work and leadership.

• 1956 - elected Full Member of the National Academy of Sciences.

• 1961 - awarded the David Sarnoff Electronics Award given by the Institute of Electrical and Electronics Engineers, and the Rumford Medal awarded by the American Academy of Arts and Sciences

• 1962 - The John Carty Award given by the National Academy of Science.

• 1963 - Young Medal and Prize, for distinguished research in the field of optics presented by the Institute of physics.

• 1964 - The Nobel Prize in Physics with N. G. Basov and Aleksandr Prokhorov for contributions to fundamental work in quantum electronics leading to the development of the maser and laser.

• 1979 - He was awarded the Niels Bohr international medal awarded for contributions to the peaceful use of atomic energy.

• 1980 - Townes was inducted by his home state into the South Carolina Hall of Science and Technology, and has also been awarded a South Carolina Hall of Science and Technology Citation.

• 1982 - He received the National Medal of Science, presented by President Ronald Reagan.

• 1994 - elected Foreign Member of the Russian Academy of Sciences.

• 1998 - awarded the Henry Norris Russell Lectureship by the American Astronomical Society.

• 2000 - awarded the Lomonosov Medal by the Russian Academy of Sciences.

• 2003 - awarded the Telluride Tech Festival Award of Technology in Telluride, Colorado.

• 2005 - awarded the Templeton Prize for "Progress Toward Research or Discoveries about Spiritual Realities."

• He has also been awarded the LeConte Medallion.

• 2006 - Along with associate Raj Reddy, Townes was awarded the Vannevar Bush Award for Lifetime Contributions and Statesmanship to Science

• 2008 - On May 24 Townes received an Honorary Doctorate of Humane Letters from the University of Redlands.

Representation

• Between 1966 and 1970 he was chairman of the NASA Science Advisory Committee for the Apollo lunar landing program.

Personal details

He was born in Greenville, South Carolina to Baptist parents. He is a brother of Pi Kappa Phi, Delta Chapter. He is a Protestant Christian, and is a member of the United Church of Christ. His father was an attorney. He has four daughters and seven grandchildren. He considers that "science and religion [are] quite parallel, much more similar than most people think and that in the long run, they must converge".[1]

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See also

List of science and religion scholars

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^ Harvard Gazette June 16, 2005 Laser's inventor predicts meeting of science, religion

External links

• http://www.hno.harvard.edu/gazette/2005/06.16/05-laser.html

• Charles Hard Townes

• Amazing Light: Visions of Discovery (Symposium in honor of Charles Townes

• Infrared Spatial Interferometer Array

• Research page

• Oral History interview transcript with Charles H. Townes 20 and 21 May 1987, American Institute of Physics, Niels Bohr Library and Archives

• Dedication Program for the Charles H. Townes Center for Science, Furman University, November 1, 2008

Gordon Gould (July 17, 1920 – September 16, 2005) was an American physicist who is widely, but not universally, credited with the invention of the laser. Gould is best known for his thirty-year fight with the United States Patent and Trademark Office to obtain patents for the laser and related technologies. He also fought with laser manufacturers in court battles to enforce the patents he subsequently did obtain.

Early life and education

Born in New York City, Gould was the oldest of three sons. Both his parents were Methodists active in their community church, but he himself was an avowed atheist. His father was the founding editor of Scholastic Magazine Publications in New York City. He earned a Bachelor of Science degree in physics at Union College, where he became a member of the Sigma Chi Fraternity, and a Master's degree at Yale University, specializing in optics and spectroscopy. Between March 1944 and January 1945 he worked on the Manhattan Project but was dismissed due to his activities as a member of the Communist Political Association. In 1949 Gould went to Columbia University to work on a doctorate in optical and microwave spectroscopy. His doctoral supervisor was Nobel laureate Polykarp Kusch, who guided Gould to develop expertise in the then-new technique of optical pumping. In 1956, Gould proposed using optical pumping to excite a maser, and discussed this idea with the maser's inventor Charles Townes, another Nobel laureate who was also a professor at Columbia. Townes gave Gould advice on how to obtain a patent on his innovation, and agreed to act as a witness.[1]

Invention of the laser

By 1957, many scientists including Townes were looking for a way to achieve maser-like amplification of visible light. In November of that year, Gould realized that one could make an appropriate optical resonator by using two mirrors in the form of a Fabry-Pérot interferometer. Unlike previously-considered designs, this approach would produce a narrow, coherent, intense beam. Since the sides of the cavity did not need to be reflective, the gain medium could easily be optically pumped to achieve the necessary population inversion. Gould also considered pumping of the medium by atomic-level collisions, and anticipated many of the potential uses of such a device. Gould recorded his analysis and suggested applications in a laboratory notebook under the heading "Some rough calculations on the feasibility of a LASER: Light Amplification by Stimulated Emission of Radiation"—the first recorded use of this acronym.[2] Gould's notebook was the first written prescription for making a viable laser and, realizing what he had in hand, he took it to a neighborhood store to have his work notarized. Arthur Schawlow and Charles Townes independently discovered the importance of the Fabry-Pérot cavity—about three months later—and called the resulting proposed device an "optical maser".[3] Gould's name for the device was first introduced to the public in a conference presentation in 1959, and was adopted despite resistance from Schawlow and his colleagues[4][5] Eager to achieve a patent on his invention, and believing incorrectly that he needed to build a working laser to do this, Gould left Columbia without completing his doctoral degree and joined a private research company, TRG (Technical Research Group). He convinced his new employer to support his research, and they obtained funding for the project from the Advanced Research Projects Agency, ironically with support from Charles Townes. Unfortunately for Gould, the government declared the project classified, which meant that a security clearance was required to work on it. Because of his former participation in communist activities, Gould was unable to obtain a clearance. He continued to work at TRG, but was unable to contribute directly to the project to realize his ideas. Due to technical difficulties and perhaps Gould's inability to participate, TRG was beaten in the race to build the first working laser by Theodore Maiman at Hughes Research Laboratories

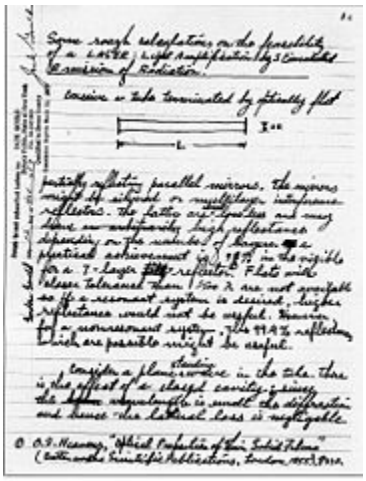

Figure 74. The first page of the notebook in which Gould coined the acronym LASER and described the essential elements for constructing one.

Patent battles

During this time, Gould and TRG began applying for patents on the technologies Gould had developed. The first pair of applications, filed together in April 1959, covered lasers based on Fabry-Pérot optical resonators, as well as optical pumping, pumping by collisions in a gas discharge (as in helium-neon lasers), optical amplifiers, Q-switching, optical heterodyning, the use of Brewster's angle windows for polarization control, and applications including manufacturing, triggering chemical reactions, measuring distance, communications, and lidar. Schawlow and Townes also applied for a patent on the laser, which was granted on March 22, 1960. Gould and TRG launched a legal challenge, based on the precedence established by his notarized notebook from 1957. While this challenge was being fought in the Patent Office and the courts, further applications were filed on specific laser technologies by Bell Labs, Hughes Research Laboratories, Westinghouse, and others. Gould ultimately lost the battle for the U.S. patent on the laser itself, primarily on the grounds that his notebook did not explicitly say that the sidewalls of the laser medium were to be transparent, even though he planned to optically pump the gain medium through them, and considered loss of light through the sidewalls by diffraction.[6] Questions were also raised about whether Gould's notebook provided sufficient information to allow a laser to be constructed, given that Gould's team at TRG was unable to do so. Gould was able to obtain patents on the laser in several other countries, however, and he continued fighting for U.S. patents on specific laser technologies for many years afterward.

In 1967, Gould left TRG and joined the Polytechnic Institute of Brooklyn, now the Polytechnic University of New York, as a professor. While there, he proposed many new laser applications, and arranged government funding for laser research at the Institute. Gould's first laser patent was awarded in 1968, covering an obscure application—generating X-rays using a laser. The technology was of little value, but the patent contained all the disclosures of his original 1959 application, which had previously been secret. This allowed the patent office greater leeway to reject patent applications that conflicted with Gould's pending patents.[7] Meanwhile the patent hearings, court cases, and appeals on the most significant patent applications continued, with many other inventors attempting to claim precedence for various laser technologies. By 1970, TRG had been bought by Control Data Corporation, which had little interest in lasers and was disposing of that part of the business. Gould was able to buy back his patent rights for a thousand dollars, plus a small fraction of any future profits. In 1973, Gould left the Polytechnic Institute of Brooklyn to help found Optelecom, a company in Gaithersburg, Md. that makes fiberoptic communications equipment. He later left his successful company in 1985 because it was "boring."

Patents, and enforcement

Shortly after starting Optelecom, Gould and his lawyers changed the focus of their patent battle. Having lost many court cases on the laser itself, and running out of appeal options, they realized that many of the difficulties could be avoided by focusing instead on the optical amplifier, an essential component of any laser. The new strategy worked, and in 1977 Gould was awarded U.S. patent #4,053,845, covering optically-pumped laser amplifiers. The laser industry, by then grown to annual sales of around $400 million, rebelled at paying royalties to license the technology they had been using for years, and fought in court to avoid paying. The industry outcry caused the patent office to stall on releasing Gould's other pending patents, leading to more appeals and amendments to the pending patents. Despite this, Gould was issued U.S. Patent 4,161,436 in 1979, covering a variety of laser applications including heating and vaporizing materials, welding, drilling, cutting, measuring distance, communication systems, television, laser photocopiers and other photochemical applications, and laser fusion. The industry responded with lawsuits seeking to avoid paying to license this patent as well. Also in 1979, Gould and his financial backers founded the company Patlex, to hold the patent rights and handle licensing and enforcement.

The legal battles continued, as the laser industry sought to not only prevent the Patent Office from issuing Gould's remaining patents, but also to have the already-issued ones revoked. Gould and his company were forced to fight both in court, and in Patent Office review proceedings. According to Gould and his lawyers, the Office seemed determined to prevent Gould from obtaining any more patents, and to rescind the two that had been granted.[8] Things finally began to change in 1985. After years of legal process, the Federal Court in Washington, DC ordered the Patent Office to issue Gould's patent on collisionally-pumped laser amplifiers. The Patent Office appealed, but was ultimately forced to issue U.S. Patent 4,704,583 , and to abandon its attempts to rescind Gould's previously-issued patents. The Brewster window patent was later issued as U.S. Patent 4,746,201 . The end of the Patent Office action freed Gould's enforcement lawsuits to proceed. Finally, in 1987, Patlex won its first decisive enforcement victory, against Control Laser corporation, a manufacturer of lasers. Rather than be bankrupted by the damages and the lack of a license to the technology, the Board of Control Laser turned ownership of the company over to Patlex in a settlement deal. Other laser manufacturers and users quickly agreed to settle their cases and take out licenses from Patlex on Patlex's terms.

The thirty year patent war that it took for Gould to win the rights to his inventions became known as one of the most important patent battles in history. In the end, Gould was issued forty-eight patents, with the optical pumping, collisional pumping, and applications patents being the most important.[9] Between them, these technologies covered most lasers used at the time. For example, the first operating laser, a ruby laser, was optically pumped; the helium-neon laser used in many bar code scanners is pumped by gas discharge. The delay — and the subsequent spread of lasers into many areas of technology — meant that the patents were much more valuable than if Gould had won initially. Even though Gould had signed away eighty percent of the proceeds in order to finance his court costs, he made several million dollars.[10] "I thought that he legitimately had a right to the notion to making a laser amplifier," said William R. Bennett, who was a member of the team that built the first laser that could fire continuously. "He was able to collect royalties from other people making lasers, including me."

Later life

Controversy over who was the true inventor of the laser, fueled by Townes and Schawlow's claims, followed Gould his whole life. In 1991, Gould was elected to the National Inventors Hall of Fame. Gould said in his acceptance speech: "I think it's important to be self-critical. You have to weed out all of the aspects of an idea that aren't going to work, or reject the entire idea in favor of some new idea. You have to be encouraged to try things, even if they don't work." Gould died on September 16, 2005 of natural causes. He was survived by his wife of 35 years, Marilyn Appel.[10]

See also

• Robert Kearns, another inventor who fought a long battle to enforce his patents.

• Edwin H. Armstrong, another inventor who fought a long and acrimonious battle to enforce his patents.

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Beam: The Race to Make the Laser by Jeff Hecht. Review

"Hecht tells the story of the several competing laboratories that were attempting in the late 1950s to use the phenomenon of simulated emission to produce a coherent and monochromatic light source. The story is interesting in its own right, both to physicists and engineers interested in the intellectual climate of the time and to the general public as an example of excitement and competition within the scientific community."—CHOICE. In 1954, Charles Townes invented the laser's microwave cousin, the maser. The next logical step was to extend the same physical principles to the shorter wavelengths of light, but the idea did not catch fire until October 1957, when Townes asked Gordon Gould about Gould's research on using light to excite thallium atoms. Each took the idea and ran with it. The independent-minded Gould sought the fortune of an independent inventor; the professorial Townes sought the fame of scientific recognition. Townes enlisted the help of his brother-in-law, Arthur Schawlow, and got Bell Labs into the race. Gould turned his ideas into a patent application and a million-dollar defense contract. They soon had company. Ali Javan, one of Townes's former students, began pulling 90-hour weeks at Bell Labs with colleague Bill Bennett. And far away in California a bright young physicist named Ted Maiman became a very dark horse in the race. While Schawlow proclaimed that ruby could never make a laser, Maiman slowly convinced himself it would. As others struggled with recalcitrant equipment and military secrecy, Maiman built a tiny and elegant device that fit in the palm of his hand. His ruby laser worked the first time he tried it, on May 16, 1960, but afterwards he had to battle for acceptance as the man who made the first laser. Beam is a fascinating tale of a remarkable and powerful invention that has become a symbol of modern technology.

City of Light: The Story of Fiber Optics by Jeff Hecht. Amazon.com Review

Computers you notice. They sit on your desk and hum, ever smaller, ever faster, and always obsolete if bought longer ago than last week. But the equally impressive technology that turns millions of terminals into a global network is less obvious. The phone line that comes into your house probably still pushes electrons through metal. But not far away, the signal will join millions of others relayed down fiber optic cables by laser. Jeff Hecht's fascinating account of this under sung technology goes back 150 years to find the origins of fiber optics. Then he chronicles the many ingenious and determined engineers who fashioned it into a technology that festoons the globe with cables carrying pulses of photons. It was harder than pioneering copper links because supplanting an existing technology needs more persuasion than establishing the first one. And there was competition from the satellite industry, as well as unexpected setbacks, such as sharks who ignored copper but chewed fiber optic cables. Hecht tells a good tale, combining a light journalistic touch with a scholarly knowledge of the industry he has covered for over two decades. The story is not over yet, but this is a rich account of how we got this far in a technology that really has fueled a revolution. --*Jon Turney, Amazon.co.uk*

From Publishers Weekly

The first underwater telegraph cable was laid between England and the Continent in 1850, with the cable from America to Europe following in 1858. But for the next century, improvements in transcontinental communication came slowly. By the 1940s, Americans could talk to Europeans via a static-plagued radiophone. By the early 1980s, satellite transmissions had improved conversation clarity significantly, but callers were still annoyed by delay and feedback. Those who have made a transcontinental call recently, however, know that the wonders of fiber optics have made it possible to hear a pin drop on the Champs-Elysees. In this deft history, Hecht, a writer for the British weekly New Scientist, shows how the illuminated fountains that thrilled crowds at the great 19th-century exhibitions convinced scientists that light can be guided along narrow tubes. In our century, scientists used these tubes of light first to look inside the human body and then, as the physics of wave transmission were better understood, to transmit audio and optical information. Hecht explains which technological advances have made fiber optics the backbone of our telephone system in the last 10-15 years and how everyday applications should increase exponentially once fibers are connected directly to our homes. Already optical fibers are used in many surprising ways: guiding laser light in life-saving surgery; embedded in concrete to monitor stress in bridges; wound into gyroscopes to improve airline safety. Hecht's latter chapters are bogged down slightly with details that will mainly interest readers working in related areas, but general science buffs should enjoy his account of the development of the technology that will change our lives in many unexpected ways in the next quarter century.

The History of the Laser by Mario Bertolotti Review

Bertolotti's entertaining book gives a good sense of the long history of the development of ideas which finally resulted in the laser-Streams, Volume 8, no. 9, 2005. This rather scholarly work-much more than a mere history of the laser-sets out to cover a huge canvas. The origins of the science of optics, Newtonian mechanics, the wave theory of light, statistical mechanics, the old quantum theory, quantum mechanics, atomic physics and spectroscopy are all traced via detailed accounts of the life histories of the main protagonists. …readers familiar with the underlying science will find the glimpses into the lives of the hundred or more personalities truly fascinating. The book also contains a fine gallery of photographs of the scientists whose work contributed to the history and prehistory of the laser.-*Collin Webb, Times Higher Education Supplement*

Synopsis

Since the invention of the first working laser in 1960, development of these devices has progressed at an unprecedented rate, to the extent that the laser is now a common part of everyday life, from the semiconductor laser used in CD players and telecommunication systems to the high power eximer lasers used in manufacturing processes. This book traces the history of the laser, from the first theoretical predictions of stimulated emission made in the 1920s, through the experimental development of masers and lasers in the 50s and 60s, to the advanced applications of lasers in the present day. Along the way it tells the fascinating and at times controversial story of the people behind the discoveries. Written in a style suitable for the general public, it will be of interest to those working within the laser community, and to anyone with an interest in the history of science.

Lasers by A. E. Siegman @ http://www.stanford.edu/~siegman/index.html. Review "An extraordinary tutorial text particularly for use by graduate students as well as an invaluable reference for the seasoned professional." -- *IEEE Spectrum*. "LASERS is a remarkably well written book that should become the standard introductory text on laser physics." -- *Optical and Quantum Electronic News*

"The classic pedagogical treatment of the subject." -- *Physics Today*. Lasers is both a textbook and a general reference book with an emphasis on basic laser principles and theory. A unique feature is that it gives a complete, detailed, and accurate treatment of laser physics, building only on classical models, without requiring the reader to have a quantum mechanical background. It is for all scientists and engineers who work with lasers… This is universally regarded as the ultimate reference for lasers. After discovering it in grad school, I understand why! Siegman's explanations are truly phenomenal and "Lasers" treats virtually every topic on lasers. Plus, he has comprehensive errata on his website! The greatest reference! If you are looking for quick answers and canned solutions - this is not book for you. Alost all there is to know about lasers… Unlike many optics-oriented books, the math in this book will be

more familiar to engineers. Most others are written from a Physicist's perspective. An excellent reference for general optics, as well as lasers. More rigorous than many other titles.

TELECOSM: How Infinite Bandwidth will Revolutionize Our World by George Gilder "The supreme abundance of the telecosm is the electromagnetic spectrum, embracing all the universe of vibrating electrical and magnetic fields, from power line pulses through..." Amazon.com Review. And he said, "Let the computer age be over." And so it was. George Gilder, the tech-friendly author of the well-received chip treatise, *The Meaning of the Microcosm*, and publisher of the *Gilder Technology Report*, has brought forth *Telecosm: How Infinite Bandwidth Will Revolutionize Our World*, another work of technical prose that's sure to appeal to both techheads and nontechnical folks alike. *Telecosm* predicts a revolutionary new era of unlimited bandwidth: it describes how the "age of the microchip"--dubbed the "microcosm"--is ending and leaving in its wake a new era--the "telecosm," or "the world enabled and defined by new communications technology." Speaking like a prophet of the bandwidth deity, Brother Gilder lays down the telecosmic commandments--the Law of the Telecosm, Gilder's Law, the Black Box Law, and so on. He describes the gaggle of industry players--from cable and satellite to telephone and computer--who populate the telecosm arena.

Books about telecommunications rarely are quotable, but Telecosm at times is a brilliant example of magical and (believe it or not) mystical prose. Gilder's philo-techno perspective makes for interesting and thought-provoking musings: "Wrought of sand, oxygen, and aluminum, the three most common substances in the Earth's crust, the microprocessor distills ideas as complex as a street map of America onto a sliver of silicon the size of a thumbnail. This gift of the quantum is a miracle of compression." And, finally, he describes precisely what the telecosm will create among its congregation: "The gift of the telecosm is a miracle of expansion: grains of sand spun into crystalline fibers and woven into worldwide webs."What happens when we become blessed with the miracle of infinite bandwidth? Gilder writes, "You can replace the seven-layer smart network with a much faster, dumber, unlayered one. Let all messages careen around on their own. Let the end-user machines take responsibility for them. Amid the oceans of abundant bandwidth, anyone who wants to drink just needs to invent the right kind of cup." And what of unlimited bandwidth? No mere contradiction in terms, unlimited bandwidth is what we strive for--"we" meaning those of us who suffer bravely through the contradictions of Moore's Law and Metcalfe's Law, as we increase our RAM and decrease our Net access time. While it seems too simple to describe Telecosm as a telescopically written book of cosmic proportions, it is that and more. Gilder's political rants and raves for infinite bandwidth boldly foretell the age of the telecosm and its dramatic impact on all of us--of our metamorphosis from users who found ourselves bound by the limits of our networks to "bandwidth angels" who compute in the "Promethean light." --E. Brooke Gilbert

From Library Journal: Gilder, a highly respected and widely read technology analyst (Forbes, the Economist, the Wall Street Journal), predicts an impending "bandwidth blowout" that will reshape the way we do business and organize our lives. The author's The Meaning of Microcosm (1997) described a world dominated by the Microsoft- and Intel-based PC. In his latest work, a world enabled and dominated by new telecommunications technology will make human communication universal, instantaneous, unlimited in capacity, and free to all. Gilder explains the science and engineering trends of his predictions, who is fighting them, who will ride them to victory, and what it all means. He weaves together a number of rich and complex stories to back up his claims and provide readers with the necessary components toward understanding the pending telecosmic revolution. This book will be of interest to technologists, investors, and general-interest readers. Recommended for public and academic libraries.DJoe Accardi, Northeastern, Illinois Univ., Chicago

How Lasers Work

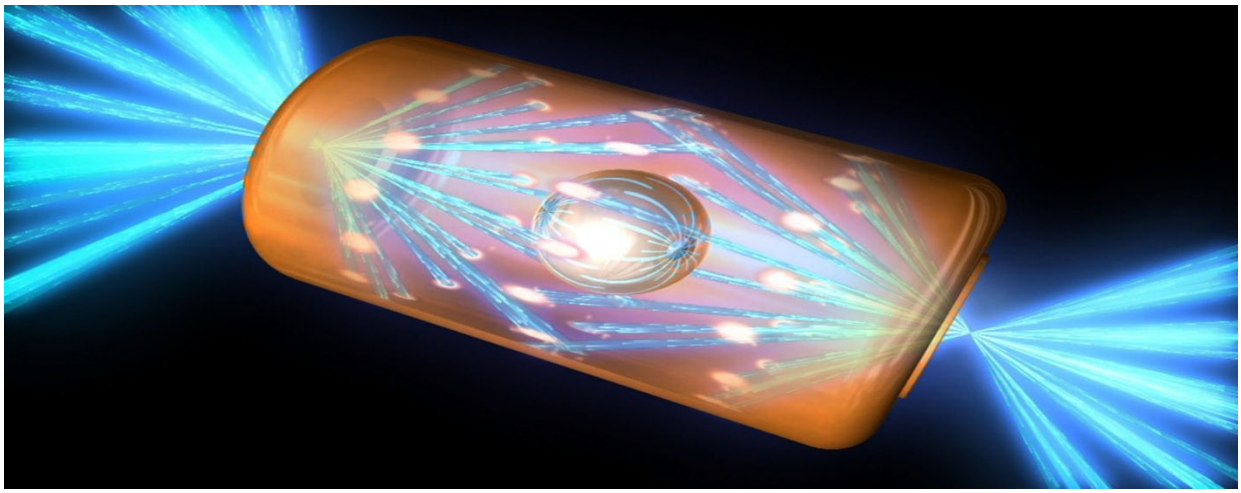

Figure 75. This artist's rendering shows a NIF target pellet inside a hohlraum capsule with laser beams entering through openings on either end. The beams compress and heat the target to the necessary conditions for nuclear fusion to occur. Ignition experiments on NIF will be the culmination of more than 30 years of inertial confinement fusion research and development, opening the door to exploration of previously inaccessible physical regimes. Credit: courtesy of Laurence Livermore Laboratory

A laser can be as small as a microscopic computer chip (silicon laser) or as immense as the National Ignition Facility (NIF), which is three football fields wide. Clearly size has nothing to do with what makes a laser. “Laser” is an acronym for light amplification by stimulated emission of radiation. If the electrons in special glasses, crystals or gases are energized, they will emit light photons in response to a weak laser pulse. The photons will all be at the same wavelength and will also be “coherent,” meaning the light wave’s crests and troughs are all in lockstep. In contrast, ordinary visible light comes in multiple wavelengths and is not coherent.

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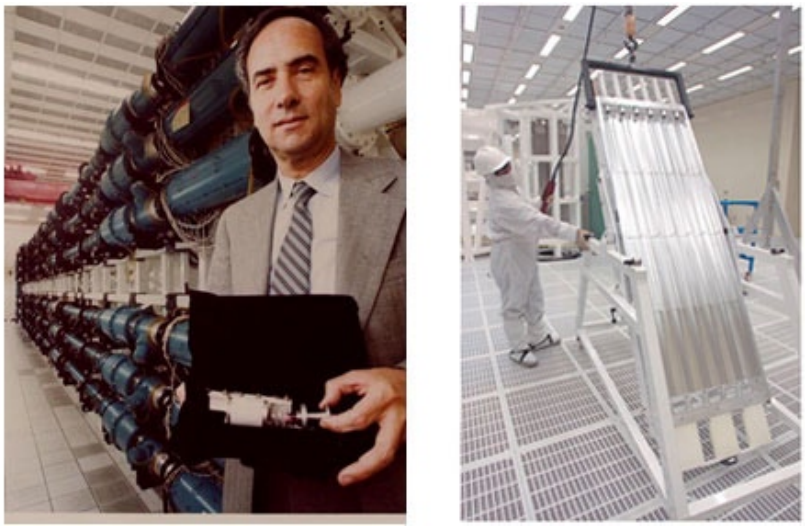


Figure 76. Flashlamps of various sizes power most lasers. The world’s first working laser, the ruby laser (left) was developed in 1960 by research physicist Theodore H. Maiman. The coiled flashlamp surrounds a small ruby rod. NIF’s two-meter-tall flashlamps, at right, are powered by the highest energy collection of electrical capacitors ever assembled. Credit: courtesy of Laurence Livermore Laboratory.

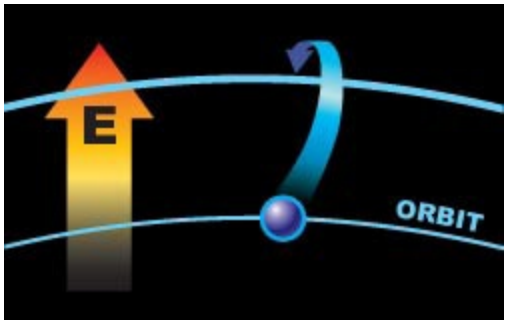


Figure 77. An atom absorbs energy in the form of heat, light, or electricity. Electrons may move from a lower-energy orbit to a higher-energy orbit. When they return their ground state, they emit a photon to.

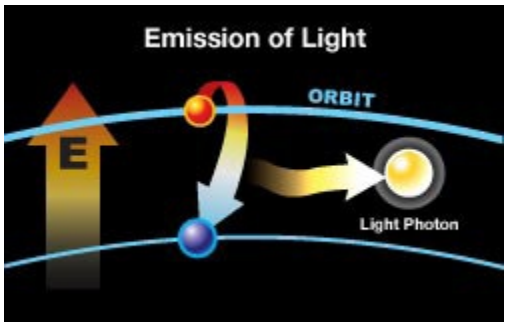


Figure 78.This process results in “amplification,” or the production of huge numbers of photons of the same wavelength and direction. In NIF, amplification produces trillions upon trillions of photons – 1023 photons to be precise (see Amplifiers). As the photons encounter each other inside the laser amplifier, they vibrate coherently with the same frequency and direction. In essence, the photons “clone” themselves, creating a perfect copy of the first photon. Coherence causes the light to shine in a beam that is extremely bright and straight, familiar to anyone who has used a laser pointer.

Figure 79. Laser glass slabs are stacked four high and two wide to accommodate a bundle of eight beams in each amplifier assembly. **Each NIF beamline contains two large amplifier sections** designed to efficiently amplify the nominal one-joule input pulse from the injection laser system to each of the 192 beams to the required power and energy while controlling the input beam’s spatial, spectral and temporal characteristics. The amplifiers, with 16 glass slabs per beam (and a capability for 18 slabs per beam if necessary), are arranged in two amplifier sections, the main amplifier and the power amplifier. Together, these amplifiers provide 99.99 percent of NIF’s power and energy. When fully integrated with laser amplifier glass, flash lamps, pulsed power and other related components, the amplifiers are physically the largest of NIF’s integrated systems occupying approximately one fourth of the facility floor space. Credit: courtesy of Laurence Livermore Laboratory.

The initial weak pulse has by now been amplified and increased enormously in energy. In small lasers, a partially reflecting mirror at one end of the lasing medium is designed to allow some of the amplified light – now laser light – to pass through (see “The First Ruby Laser” below). In NIF, a special optical switch traps the low-energy laser pulse in the main amplifier for four passes back and forth through the laser glass slabs. Only then are the laser beams switched out of the main amplifier to continue their journey to the target chamber. This system of glass, mirrors, and other special optics is known as a laser amplifier cavity. Precise design of the amplifier components allows scientists to control how much energy the laser beam will produce. In NIF, a series of amplifiers increases the energy of the initial weak pulse of light by more than a quadrillion times to create NIF’s 192 highly energetic, tightly focused laser beams.

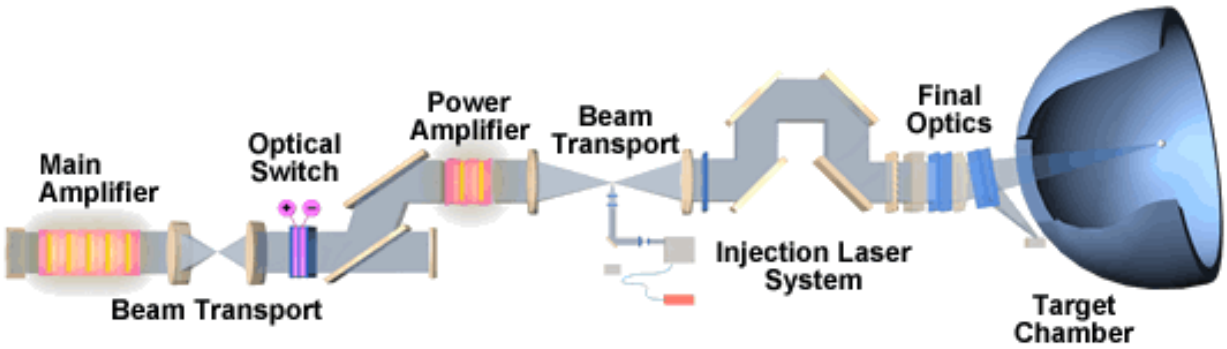


Figure 80. Every NIF beam starts at the master oscillator (bottom center). The low-energy beam is amplified in the preamplifier module and then in the power amplifier, the main amplifier, and again in the power amplifier before it runs through the switchyard and into the target chamber. Credit: courtesy of Laurence Livermore Laboratory.[368]

NIF's 192 laser beams travel a long path, about 1,000 feet, from their birth at one of the two master oscillators to the center of the target chamber. As the beams move through NIF's amplifiers, their energy increases exponentially. From beginning to end, the beams' total energy grows from one-billionth of a joule to four million joules, a factor of more than a quadrillion – and it all happens in less than 25 billionths of a second.

Each master oscillator generates a very small, low-energy laser pulse. The pulse may range from 100 trillionths to 25 billionths of a second long, and has a specific temporal shape as requested by NIF experimenters. The low-energy pulse is carried on optical fibers to 48 preamplifier modules for initial amplification and beam conditioning. In the preamplifiers the energy is increased by a factor of ten billion to a few joules. The 48 beams from the 48 preamplifiers are then split into four beams each for injection into the 192 main laser amplifier beamlines (see Injection Laser System).

Figure 81. An optical switch is tested in cleanroom conditions in NIF's Optics Assembly Building. Credit: courtesy of Laurence Livermore Laboratory.

Each beam zooms through two systems of large glass amplifiers, first through the power amplifier and then into the main amplifier. In the main amplifier, a special optical switch called a plasma electrode Pockels cell (PEPC) traps the light, forcing it to travel back and forth four times through 11 sets of laser amplifier glass slabs before it can exit the main amplifier cavity. Without this optical switch, the NIF main laser building would have to be about 750 feet longer to achieve the same amplification.

From the main amplifier, the beam makes a final pass through the power amplifier before speeding into the target chamber. As the pulse's energy is being amplified, a special deformable mirror and other devices (see NIF Optics) ensure that the beams are of high quality, uniformity and smoothness.

NIF's large glass amplifiers are unique. Other large laser systems use a series of amplifiers of increasing size to raise the beam's energy. NIF's amplifiers are all the same size and use more than 3,000 one-meter-long slabs of special phosphate glass doped with neodymium atoms.

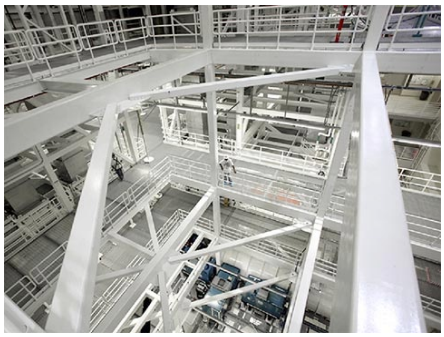


Figure 82. The NIF switchyard directs the 192 laser beams into the target chamber and the precision diagnostic system. Credit: courtesy of Laurence Livermore Laboratory.

A split second before the initial weak laser pulse begins life at the master oscillator, more than 7,500 two-meter-long flashlamps, powered by huge capacitors that store electricity (see Power Conditioning System), energize the neodymium atoms in the amplifier glass by bathing them in intense white light (see How Lasers Work). When the laser beams leave the preamplifiers, the amplifiers are already powered up and ready to receive them. After passing through all the amplifiers, each NIF laser beam has been amplified to about 20,000 joules of energy.

Figure 83. The target chamber is hoisted by a crane and prepared for installation in the NIF target bay. Credit: courtesy of Laurence Livermore Laboratory.

A complex system of special mirrors in two ten-story steel structures known as “switchyards” rearrange the parallel, linear array of 192 laser beams into a spherical configuration so that the beams can be focused into the center of the target chamber. Among the stiffest structures ever built, the switchyard’s towers are built to resist vibration and are firmly anchored to the inside of the building’s four-foot-thick reinforced concrete walls. Each beam passes through a final optics assembly that converts the wavelength of the laser from infrared to ultraviolet and is focused through a final focus lens onto a target located at the chamber’s center. Targets are located with a precision that is measured in fractions of the thickness of a sheet of paper. The ability to achieve such precise alignment has been demonstrated with the first four activated beams (see NIF Early Light) and with subsequent experimental tests as additional beams were brought online.

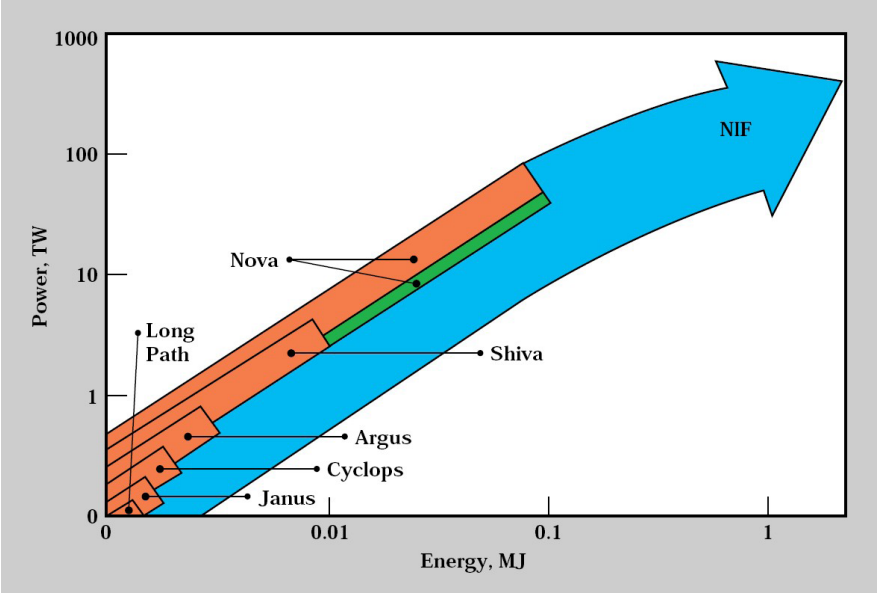


Figure 84. Plot of the parameter space occupied by various LLNL neodymium glass lasers used for inertial confinement fusion research. Both power (TeraWatts) and energy (Mega Joules of the lasers has increased exponentially since research began on them in the early '70's.[369] Credit; courtesy of Wikipedia.

NIF's arena-sized building houses 192 laser beams designed to deliver 1.8 million joules of ultraviolet laser energy and 500 terawatts of power to millimeter-sized targets located at the center of its 10-meter-diameter target chamber. The Injection Laser System creates a precisely shaped nanojoule-level laser pulse, which is amplified by a factor of more than 1,000,000 before entering the laser beampath. There, two stages of Laser Amplifiers again increase the laser energy, using the world's largest optical switch to enable multi-pass amplification. Beam Transport components direct the beams through the laser beampath while adaptive optics eliminates wavefront aberrations and opto-mechanical components smoothing and filter the beams, retaining their specific spatial and temporal characteristics. Final Optics Assemblies convert the wavelength of the laser from near infrared to ultraviolet and precisely focus the beams to the target chamber center, for the purpose of creating extreme temperatures and pressures in high energy density experiments or for creating conditions necessary to achieve fusion ignition."[370]

As we witnessed above the NIF's explicit goal is not only the investigation of the fusion plasma physics of the stars but more importantly its recreation. In 2/06 the NIF announced that its project has surpassed the expected performance criteria and is well on track to the production of unlimited Laser Light energy in the nuclear fusion reactor, providing the means for an era of limitless energy. "First Bundle Yields 152-kJ Output December 2005. Shots performed in early August 2005 with eight beams in the National Ignition Facility (NIF) achieved 136 kilojoules (kJ) of infrared laser light. This performance surpassed NIF's Main Laser Operational Qualification goal of 125 kJ for a "bundle" of eight beams. Later in August, NIF's first bundle outdid itself in a series of 10 shots that achieved 152.8 kJ using a 10-nanosecond, flat pulse. October 2004 marked the end of the NIF Early Light effort, during which 4 of an eventual 192 beamlines were installed and commissioned and 400 test shots were fired. By August 2005, the operational qualification of another quad of beamlines was complete, bringing the total of operational beamlines to 8." [371]

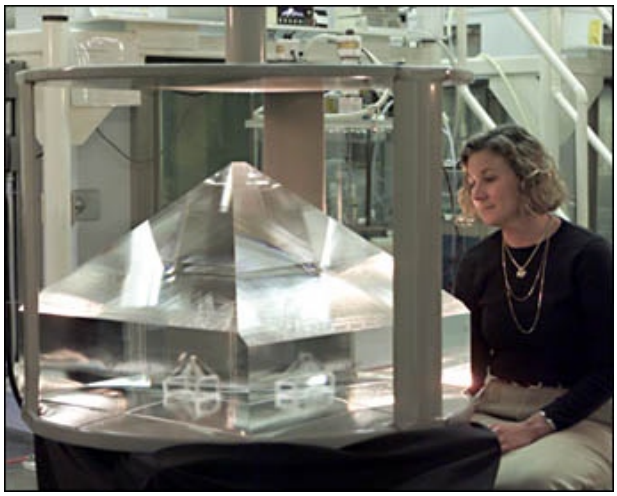


Figure 85. NIF Optics: One of the major highlights of the technology development for the National Ignition Facility (NIF) is optics. NIF's KDP crystals (shown above) serve two functions: frequency conversion and polarization rotation. Credit: courtesy of Laurence Livermore Laboratory.

The significance of mirror numbers (21-12) is clearly illustrated in the solid-state crystals of laser devices. In number theory they are called palindromes (palin, again + dramein, to run = a word, phrase or sentence which reads the same backward or forward). "Mirrors at each end reflect the photons back and forth, continuing this process of stimulated emission and amplification. There are many types of lasers, including solid-state, gas, semiconductor, or liquid. The ruby laser is a solid-state laser. Solid-state lasers provide the highest output power of all laser types. The National Ignition Facility laser will also be a solid-state laser, but will use a special glass (rather than crystals of ruby) to amplify the initial laser pulses to very high energy levels. The NIF laser will be the most powerful laser in the world."

NIF: The 'Crown Joule' of Laser Science

The National Ignition Facility (NIF) is the world's largest laser. NIF's 192 intense laser beams will deliver to its target more than 60 times the energy of any previous laser system. When all 192 beams are operational in 2009, NIF will direct nearly two million joules of ultraviolet laser energy in billionth-of-a-second pulses to the target chamber center.

Figure 86. Three football fields could fit inside the NIF Laser and Target Area Building. Credit; courtesy of Laurence Livermore Laboratory.

When all that energy slams into millimeter-sized targets, it can generate unprecedented temperatures and pressures in the target materials – temperatures of more than 100 million degrees and pressures more than 100 billion times Earth's atmosphere. These conditions are similar to those in the stars and the cores of giant planets or in nuclear weapons; thus one of the NIF & Photon Science Directorate's missions is to provide a better understanding of the complex physics of nuclear weapons (see National Security). Researchers can also explore basic science, such as astrophysical phenomena, materials science and nuclear science (see Understanding the Universe). NIF's other major mission is to provide scientists with the physics understanding necessary to create fusion ignition and energy gain for future energy production (see Energy for the Future). NIF encompasses three interconnected buildings: the Optics Assembly Building, the Laser and Target Area Building, and the Diagnostics Building (see Virtual Tour). Inside the Optics Assembly Building large, precision-engineered laser components are assembled under stringent cleanroom conditions into special modules called line replaceable units, or LRUs, for installation into the laser system. Operation of NIF's extraordinarily energetic laser beams requires that everything in the beam's enclosures remain perfectly clean at all times. Any bit of debris, oil, or other wayward material could cause the intense light to damage the optics (see Optics). The space inside the beam enclosures typically exceeds the cleanliness of a semiconductor or pharmaceutical manufacturing plant.

Extraordinary Precision

Every NIF experimental shot requires the coordination of up to 60,000 control points for electronic, high voltage, optical and mechanical devices – motorized mirrors and lenses, energy and power sensors, video cameras, laser amplifiers and diagnostic instruments. Achieving this level of precision requires a large-scale computer control system as sophisticated as any in government service or private industry (see Integrated Computer Control System). The meticulous orchestration of these parts will result in the propagation of 192 separate nanosecond (billionth of a second)-long bursts of light over a one-kilometer path length. The 192 separate beams must have optical pathlengths equal to within nine millimeters so that the pulses can arrive within 30 picoseconds (trillionths of a second) of each other at the center of the target chamber. Then they must strike within 50 micrometers of their assigned spot on a target the size of a pencil eraser. NIF's pointing accuracy can be compared to standing on the pitcher's mound at AT&T Park in San Francisco and throwing a strike at Dodger Stadium in Los Angeles, some 350 miles away. Because the precise alignment of NIF's laser beams is extremely important for successful operation, the requirements for vibrational, thermal and seismic stability are unusually demanding. Critical beampath component enclosures (generally for mirrors and lenses), many weighing tens of tons, were located to a precision of 100 microns using a rigorous engineering process for design validation and as-installed verification.

Figure 87. Laser Bay 2, one of NIF's two laser bays, was commissioned on July 31, 2007 The Laser and Target Area Building houses the 192 laser beams in two identical bays. Large mirrors, specially coated for the laser wavelength and mounted on highly stable ten-story-tall structures, direct the laser beams through the "switchyards" and into the target bay. There they are focused to the exact center of the ten-meter-diameter, concrete shielded, one-million-pound target chamber. Construction of all the buildings and supporting utilities was completed in September 2001. All 192 enclosures for laser beams were completed in 2003.

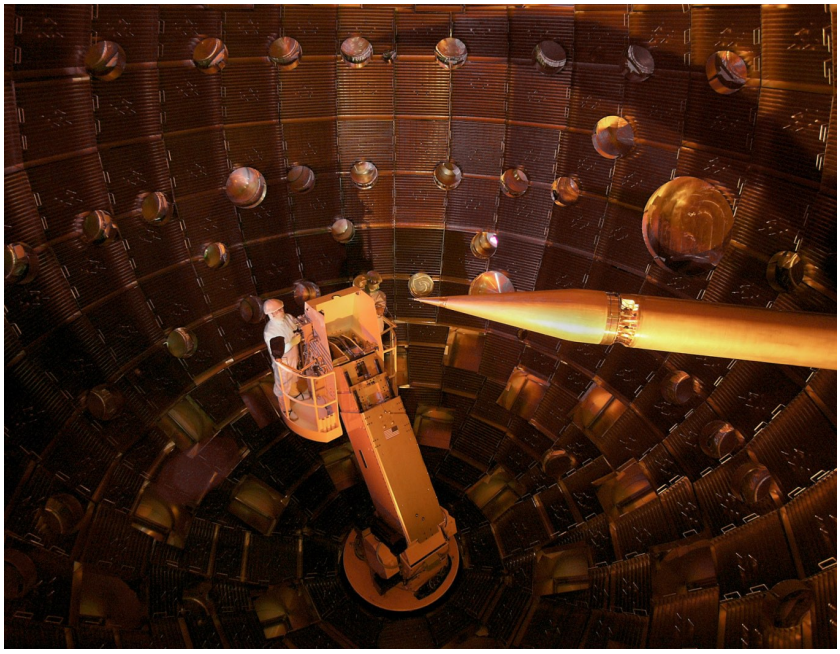


Figure 88. Technicians adjust the target positioner inside the NIF Target Chamber. Credit: courtesy of Laurence Livermore Laboratory.

Why Are There 192 Beams?

Imagine trying to squash a water balloon with two hands. No matter how hard you try to spread your fingers evenly over the surface of the balloon, it will still squirt out between your fingers. Many more fingers would be needed to compress the balloon symmetrically. Earlier high-energy lasers were used to study the conditions required to compress tiny spherical capsules to fractions of their initial diameter while still maintaining the capsule's symmetry – a crucial requirement if NIF is to achieve fusion ignition. NIF's designers arrived at 192 focused spots as the optimal number to achieve the conditions that will ignite a target's hydrogen fuel and start fusion burn.

A Variety of Experiments

Not all experiments on NIF need to produce fusion ignition. Researchers are planning many other types of experiments that will take advantage of NIF's tremendous energy and flexible geometry in non-ignition shots. Non-ignition experiments will use a variety of targets to derive a better understanding of material properties under extreme conditions. These targets can be as simple as flat foils or considerably more complex. By varying the shock strength of the laser pulse, scientists can obtain equation-of-state data that reveal how different materials perform under extreme conditions for stockpile stewardship and basic science. They also can examine hydrodynamics, which is the behavior of fluids of unequal density as they mix.

NIF experiments also will use some of the beams to illuminate "backlighter" targets to generate an X-ray flash. This allows detailed X-ray photographs, or radiographs, of the interiors of targets as the experiments progress. In addition, moving pictures of targets taken at one billion frames a second are possible using sophisticated cameras mounted on the target chamber. These diagnostics can freeze the motion of extremely hot, highly dynamic materials to see inside and understand the physical processes taking place (see Diagnostics). As construction of the 48 "quads" of four beams each proceeded, many shots were already being performed using the first quad of beams (see NIF Early Light). Experiments beginning in the winter of 2007-2008 will take advantage of additional quads as they come online.

New Technologies Make NIF Possible

Amplifying NIF's beams to record-shattering energies, keeping the highly energetic beams focused, maintaining cleanliness all along the beam's path, and successfully operating this enormously complex facility – all required NIF's designers to make major advances in existing laser technology as well as to develop entirely new technologies (see The Seven Wonders of NIF). Innovations in the design, manufacture, and assembly of NIF's optics were especially critical (see Optics).

The Seven Wonders of NIF

While construction of the football-stadium-sized National Ignition Facility was a marvel of engineering (see Building NIF), NIF is also a *tour de force* of science and technology development. To put NIF on the path to ignition experiments in 2010, scientists, engineers and technicians had to overcome a daunting array of challenges.

Working closely with industrial partners, the NIF team found solutions for NIF's optics in rapid-growth crystals, continuous-pour glass, optical coatings and new finishing techniques that can withstand NIF's extremely high energies. The team also worked with companies to develop pulsed-power electronics, innovative control systems and advanced manufacturing capabilities. Seven technological breakthroughs in particular were essential for NIF to succeed:

1. Faster, Less Expensive Laser Glass Production

Figure 89.Laser glass is the heart of the NIF laser system; it's the material that amplifies the laser light to the very high energies required for experiments. NIF's laser glass is a phosphate glass that contains a chemical additive with atoms of neodymium. The NIF laser system uses about 3,070 large plates of laser glass. Each glass plate is about three feet long and about half as wide. If stacked end-to-end, the plates would form a continuous ribbon of glass 1.5 miles long. To produce this glass quickly enough to meet construction schedules, NIF uses a new production method developed in partnership with two companies – Hoya Corporation, USA and Schott Glass Technologies, Inc. – that continuously melts and pours the glass. Once cooled, the glass is cut into pieces that are polished to the demanding NIF specifications. Read more...

2. Large Aperture Optical Switches

Figure 90. A key element of the amplifier section of NIF's laser beampath is an optical device called a plasma electrode Pockels cell, or PEPC, that contains a plate of potassium dihydrogen phosphate (KDP). This device, in concert with a polarizer, acts as a switch – allowing laser beams into the amplifier and then rotating its polarization to trap the laser beams in the amplifier section. A thin plasma electrode that is transparent to the laser wavelength allows a high electric field to be placed on the crystal, which causes the polarization to rotate. The trapped laser beams can then increase their energy much more efficiently using multiple passes back and forth through the energized amplifier glass. After the laser beams make four passes through the amplifiers, the optical switch rotates their polarization back to its normal configuration, letting them speed along their path to the target chamber. Read more...

3. Stable, High-Gain Preamplifiers

Figure 91. NIF uses 48 preamplifier modules, or PAMs, each of which provides laser energy for four NIF beams. The PAM receives a very low energy (billionth of a joule) pulse from the master oscillator room and amplifies the pulse by a factor of about a million, to a millijoule. It then boosts the pulse once again to a maximum of about ten joules by passing the beam four times through a flashlamp-pumped rod amplifier. To perform the range of experiments needed on NIF, the PAMs must perform three kinds of precision shaping of the input laser beams.

• *Spatial shaping* to make the square beam more intense around the edges to compensate for the higher gain profile in the center of the large amplifiers.

• *Spectral shaping* and beam smoothing to eliminate both hot spots and dark spots at the focus by manipulating the focal beam pattern with fast changes in wavelengths.

• *Temporal shaping* to ensure that the laser pulse delivers energy to the target with a prescribed time-history for efficient ignition. Read more...

4. Deformable Mirrors

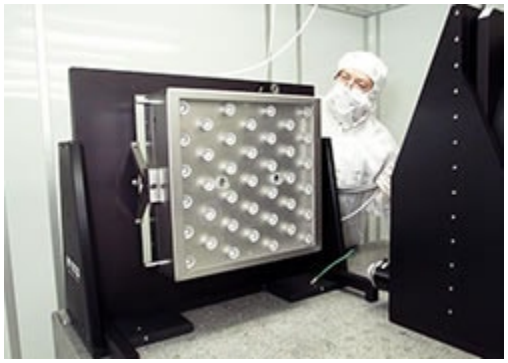


Figure 92. The deformable mirror is an adaptive optic that uses an array of actuators to bend its surface to compensate for wavefront errors in the NIF laser beams. There is one deformable mirror for each of NIF's 192 beams. Advances in adaptive optics in the atomic vapor laser isotope separation (AVLIS) program at Lawrence Livermore National Laboratory demonstrated that a deformable mirror could meet the NIF performance requirement at a feasible cost. Livermore researchers developed a full-aperture (40-centimeter-square) deformable mirror that was installed on the Beamlet laser in early 1997. Prototype mirrors from two vendors were also tested in the late 1990s. The first of NIF's deformable mirrors were fabricated, assembled and tested at the University of Rochester's Laboratory for Laser Energetics and installed and successfully used on NIF to correct wavefronts for the first beams sent to target chamber center (see NIF Early Light). Read more...

5. Large, Rapid-Growth Crystals

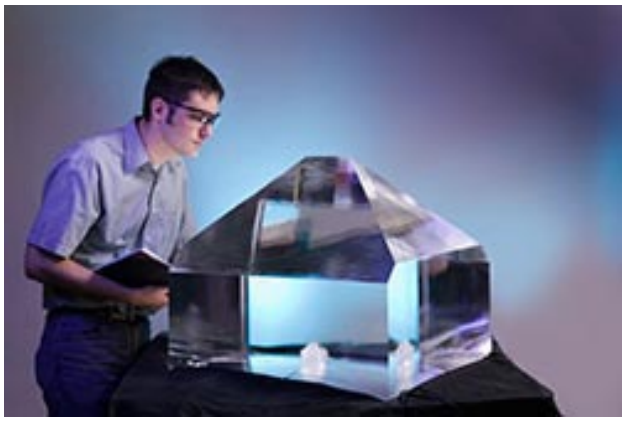


Figure 93. NIF's KDP crystals serve two functions: frequency conversion and polarization rotation (see Optical Switch). The development of the technology to quickly grow high-quality crystals was a major undertaking and is perhaps the most highly publicized technological success of the NIF project. NIF laser beams start out as infrared light, but the interaction of the beams with the fusion target is much more favorable if the beams are ultraviolet. Passing the laser beams through plates cut from large KDP crystals converts the frequency of their light to ultraviolet before they strike the target. The rapid-growth process for KDP, developed to keep up with NIF's aggressive construction schedule, is amazingly effective: Crystals that would have taken up to two years to grow by traditional techniques now take only two months. In addition, the size of the rapid-growth crystals is large enough that more plates can be cut from each crystal, so a smaller number of crystals can provide NIF with the same amount of KDP. Read more...

6. Target Fabrication

To meet the needs of NIF experiments, NIF's millimeter-sized targets must be designed and fabricated to meet precise specifications for density, concentricity and surface smoothness. When a new material structure is needed, materials scientists create the necessary raw materials. Fabrication engineers then determine whether those materials – some never seen before – can be machined and assembled. Manufacturing requirements for all NIF targets are extremely rigid.

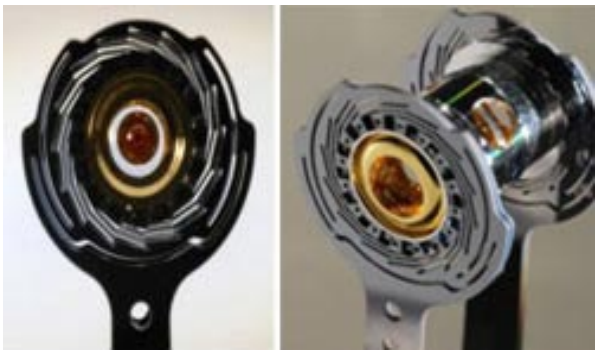


Figure 94. Components must be machined to within an accuracy of one micrometer, or one-millionth of a meter. In addition, the extreme temperatures and pressures the targets will encounter during experiments make the results highly susceptible to imperfections in fabrication. Thus, the margin of error for target assembly, which varies by component, is strict. Throughout the design process, engineers inspect the target materials and components using nondestructive characterization methods to ensure that target specifications are met and that all components are free of defects. Together, this multidisciplinary team takes an experimental target from concept to reality. Read more...

7. Integrated Computer Control System

Figure 95. Fulfilling NIF's promise requires one of the most sophisticated computer control systems in government service or private industry. Every NIF experimental shot requires the coordination of complex laser equipment. In the process, some 60,000 control points for electronic, high voltage, optical and mechanical devices – such as motorized mirrors and lenses, energy and power sensors, video cameras, laser amplifiers, pulse power and diagnostic instruments – must be monitored and controlled. The precise orchestration of these parts by NIF's integrated computer control system will result in the propagation of 192 separate nanosecond (billionth of a second)-long bursts of light over a one-kilometer path length. The 192 separate beams must have optical pathlengths equal to within nine millimeters so that the pulses can arrive within 30 picoseconds (trillionths of a second) of each other at the center of a target chamber ten meters in diameter. Then they must strike within 50 micrometers of their assigned spot on a target measuring less than one centimeter long – accuracy comparable to throwing a pitch over the strike zone from 350 miles away. Read more...[372]

The First Ruby Laser/Maser

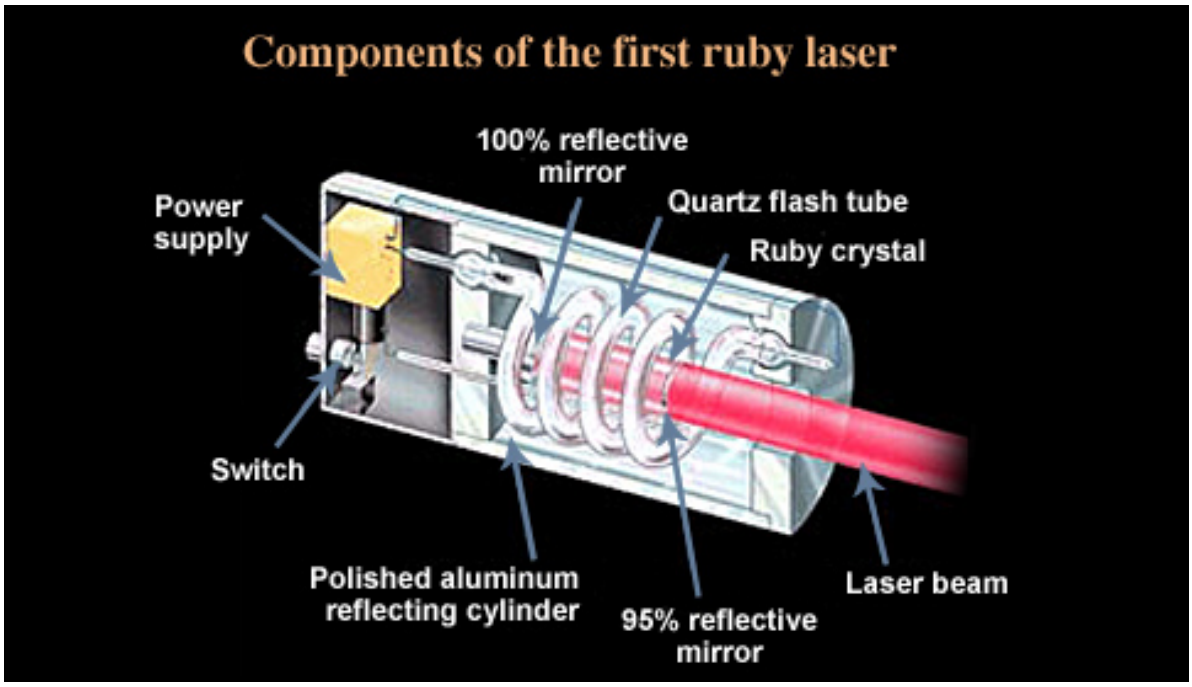


Figure 96. The ruby laser was the first laser invented in 1960. Ruby is an aluminum oxide crystal in which some of the aluminum atoms have been replaced with chromium atoms. Chromium gives ruby its characteristic red color and is responsible for the lasing behavior of the crystal. Chromium atoms absorb green and blue light and emit or reflect only red light. Credit: courtesy of Laurence Livermore Laboratory.

For a ruby laser, a crystal of ruby is formed into a cylinder. A fully reflecting mirror is placed on one end and a partially reflecting mirror on the other. A high-intensity lamp is spiraled around the ruby cylinder to provide a flash of white light that triggers the laser action. The green and blue wavelengths in the flash excite electrons in the chromium atoms to a higher energy level. Upon returning to their normal state, the electrons emit their characteristic ruby-red light. The mirrors reflect some of this light back and forth inside the ruby crystal, stimulating other excited chromium atoms to produce more red light, until the light pulse builds up to high power and drains the energy stored in the crystal.

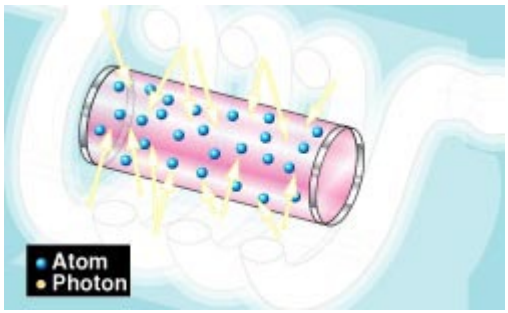


Figure 97. High-voltage electricity causes the quartz flash tube to emit an intense burst of light, exciting some of the atoms in the ruby crystal to higher energy levels.

The laser flash that escapes through the partially reflecting mirror lasts for only about 300 millionths of a second – but is very intense. Early lasers could produce peak powers of some 10,000 watts. Modern lasers can produce pulses that are billions of times more powerful. The 1,000-watt light used in modern lighthouses can be seen from 20 miles away. But beyond that distance, the light beam has spread out so much that it is difficult to see. A laser beam, however, will run straight and true for very long distances. A laser beam has been bounced off the moon to accurately measure the distance of more than 250,000 miles! The beam stays roughly the same size as it travels this vast distance. Coherence means that laser light can be focused with great precision

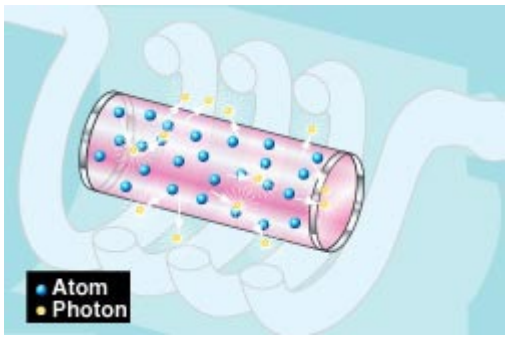


Figure 98. At a specific energy level, some atoms emit particles of light called photons. At first the photons are emitted in all directions. Photons from one atom stimulate emission of photons from other atoms and the light intensity is rapidly amplified.

Figure 99. Mirrors at each end reflect the photons back and forth, continuing this process of stimulated emission and amplification.

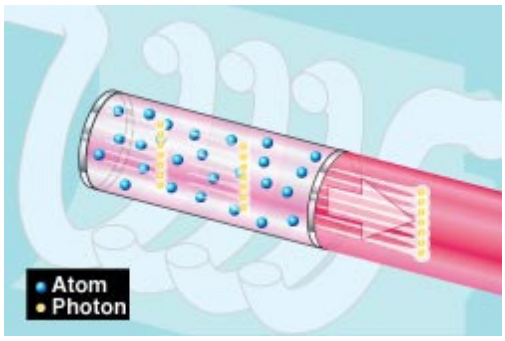


Figure 100. The photons leave through the partially silvered mirror at one end. This is laser light.

Many different materials can be used as lasers. Some, like the ruby laser, emit short pulses of laser light. Others, like helium-neon gas lasers or liquid dye lasers, emit a continuous beam of light. The ruby laser is a solid-state pulsed laser.[373]

In optics, a Fabry-Pérot interferometer or etalon is typically made of a transparent plate with two reflecting surfaces, or two parallel highly reflecting mirrors. (Technically the former is an etalon and the latter is an interferometer, but the terminology is often used inconsistently.) Its transmission spectrum as a function of wavelength exhibits peaks of large transmission corresponding to resonances of the etalon. It is named after Charles Fabry and Alfred Perot.[1]

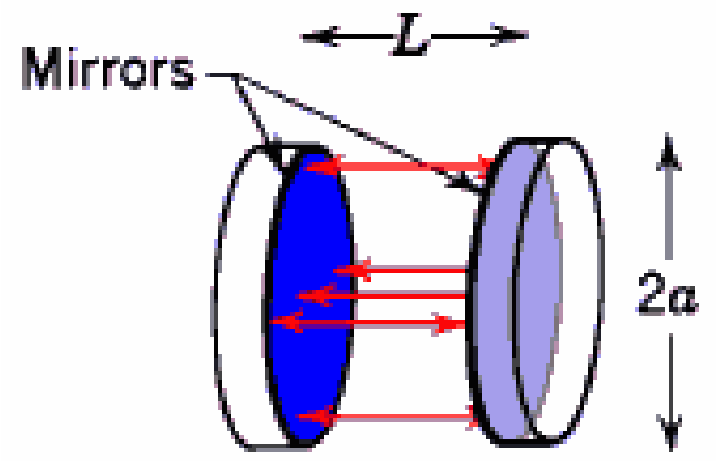


Figure 101. Fabry Perot Cavity within Maiman's Ruby Laser.

"Etalon" is from the French étalon, meaning "measuring gauge" or "standard".[2] The resonance effect of the Fabry-Pérot interferometer is identical to that used in a dichroic filter. That is, dichroic filters are very thin sequential arrays of Fabry-Pérot interferometers, and are therefore characterized and designed using the same mathematics. Etalons are widely used in telecommunications, lasers and spectroscopy to control and measure the wavelengths of light. Recent advances in fabrication technique allow the creation of very precise tunable Fabry-Pérot interferometers.[374]

The first successful optical laser constructed by Maiman (1960), consisted of a ruby crystal surrounded by a helicoidal flash tube enclosed within a polished aluminum cylindrical cavity cooled by forced air. The ruby cylinder forms a Fabry-Perot cavity by optically polishing the ends to be parallel to within a third of a wavelength of light. Each end was coated with evaporated silver; one end was made less reflective to allow some radiation to escape as a beam. The gain of a lasing medium can be enhanced by placing it between a pair mirrors to increase the effective length and restrict the allowed spatial and spectral modes of operation, greatly improving coherence and reducing pumping power requirements. This optical configuration is similar to the Fabry Perot cavity, and is the most common laser interferometer.

If the lasing medium is contained within an optical cavity the repeated passes of the stimulated emission output can enhance the gain sufficiently to create a macroscopic electromagnetic mode which can build up to produce a highly coherent, narrow output beam of extreme monochromaticity: The spectral width of the emission line can narrow by four orders of magnitude over spontaneous fluorescence or amplified spontaneous emission. In this regime of operation, a strange oscillatory behavior of the output pulse can be observed, which is attributable to an accelerated rate of stimulated emission which drives the inverted population below threshold, the lasing medium then requires a certain recovery period for the populations to build up above the threshold once again. If the ions are placed within a cavity, the gain can be significantly improved to the point where the output beam becomes coherent, extremely narrow and of significantly reduced spectral width, essentially producing a single resonant mode of electromagnetic radiation. The cavity is used not only to maintain a large enough electromagnetic field strength to stimulate emission from excited ions but also to maintain feedback and thus coherence of the output beam.

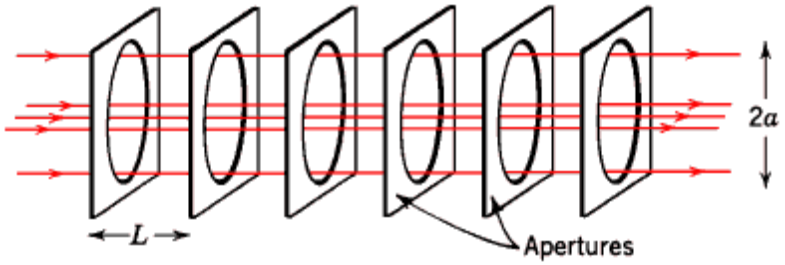


Figure 102. 'Hall of Mirrors' effect on radiation reflecting back and forth between the two mirrors of a high reflectivity laser cavity.

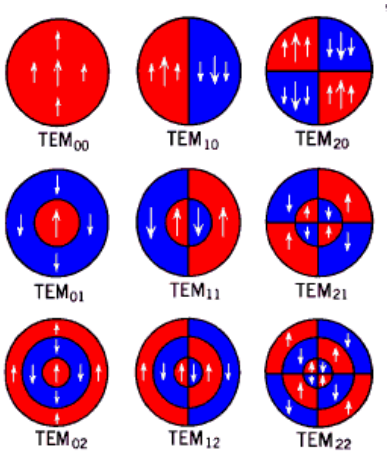


Figure 103. Electric field distribution of a few of the lowest order resonant modes of a cylindrical cavity. Up or down arrows (red or blue regions) indicate the phase of the electric field and arrow length indicates relative strength.

The optical cavity serves to

- a) Improve the gain (by multiple passes).
- b) Monochromaticity of the output beam (by Fabry-Perot mode selectivity).
- c) Coherence of the output beam, partly due to a) and partly due to b).

After Schawlow and Townes published their paper on the possibility of laser action in the infrared and visible spectrum it wasn't long before many researchers began seriously considering practical devices. Most experts were speculating that gases would be the first to lase in the optical and infrared. It came as a surprise that ruby was the first substance to produce laser action in the visible spectrum (Maiman, 1960).[375] Einstein's Laser Informed Vision of the cosmos was confirmed by NIF in the ultraviolet region of the electromagnetic spectrum. The ruby laser verified it in both the optical or visible region, as well as in the invisible or infrared with the Maser.

A maser is a device that produces coherent electromagnetic waves through amplification due to stimulated emission. Historically the term came from the acronym "Microwave Amplification by Stimulated Emission of Radiation", although modern masers emit over a broad portion of the electromagnetic spectrum. This has led some to replace "microwave" with "molecular" in the acronym, as suggested by Townes.[1] When optical coherent oscillators were first developed, they were called optical masers, but it has become more common to refer to these as lasers.

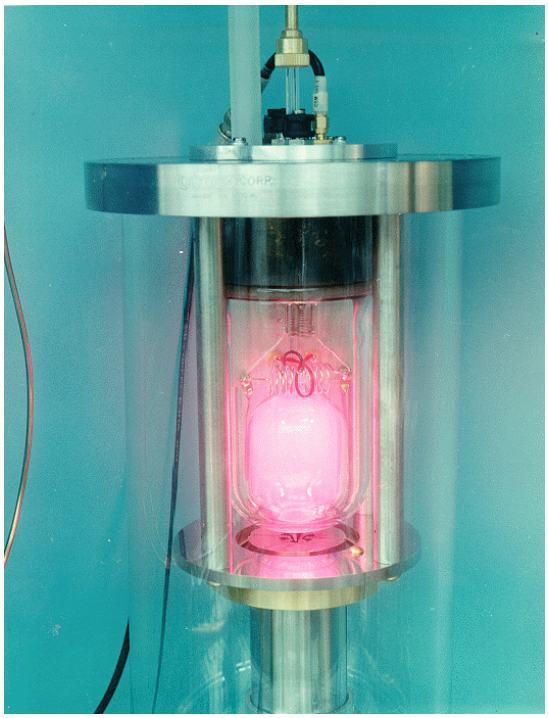


Figure 104. Hydrogen masers developed by the Smithsonian Astrophysical Observatory have been in the Deep Space Network since 1977. Its stability is equivalent to the gain or loss of 1 second in 30 million years. With use of this standard, a spacecraft navigating to Jupiter could come within 37 kilometers (23 miles) of its aiming point. Credit: Courtesy of NASA/JPL-Caltech

Theoretically, reflecting principles previously discussed by Joseph Weber at the June 1952 conference of the Institute of Radio Engineers[2] the principle of the maser was described by Nikolay Basov and Alexander Prokhorov from Lebedev Institute of Physics at an All-Union Conference on Radio-Spectroscopy held by USSR Academy of Sciences in May 1952. They subsequently published their results in October 1954. Independently, Charles H. Townes, J. P. Gordon, and H. J. Zeiger built the first maser at Columbia University in 1953. The device used stimulated emission in a stream of energized ammonia molecules to produce amplification of microwaves at a frequency of 24 gigahertz. Townes later worked with Arthur L. Schawlow to describe the principle of the optical maser, or laser, which Theodore H. Maiman first demonstrated in 1960. For their research in this field Townes, Basov and Prokhorov were awarded the Nobel Prize in Physics in 1964.[376]

There is growing evidence in support of the idea that Laser Light is the fundamental light of the cosmos, which is present in the symmetrical afterglow known today as the Cosmic Microwave Background Radiation.It was Arno Penzias and Robert Wilson who were awarded the Nobel Prize in 1978 for their detection of the Cosmic Microwave Background Radiation in 1965, thanks to their application of the Microwave Ruby Maser (Microwave Amplification by Stimulated Emission of Radiation). This cosmic microwave background radiation is to most cosmologists, the afterglow of the birth of our universe, when light separated from matter. This initial application of the Ruby Maser illustrates how the power of the laser immediately augmented our scientific vision of the universe. The law of affinity that is, like attracts like quickly opened our eyes to the coherent foundation of the world (the emergent order of the universe).

The Wilkinson Microwave Anisotropy Probe (WMAP) team has made the first detailed full-sky map of the oldest light in the universe. It is a "baby picture" of the universe. Colors indicate "warmer" (red) and "cooler" (blue) spots. The oval shape is a projection to display the whole sky; similar to the way the globe of the earth can be projected as an oval. The microwave light captured in this picture is from 379,000 years after the Big Bang, over 13 billion years ago: the equivalent of taking a picture of an 80-year-old person on the day of their birth.

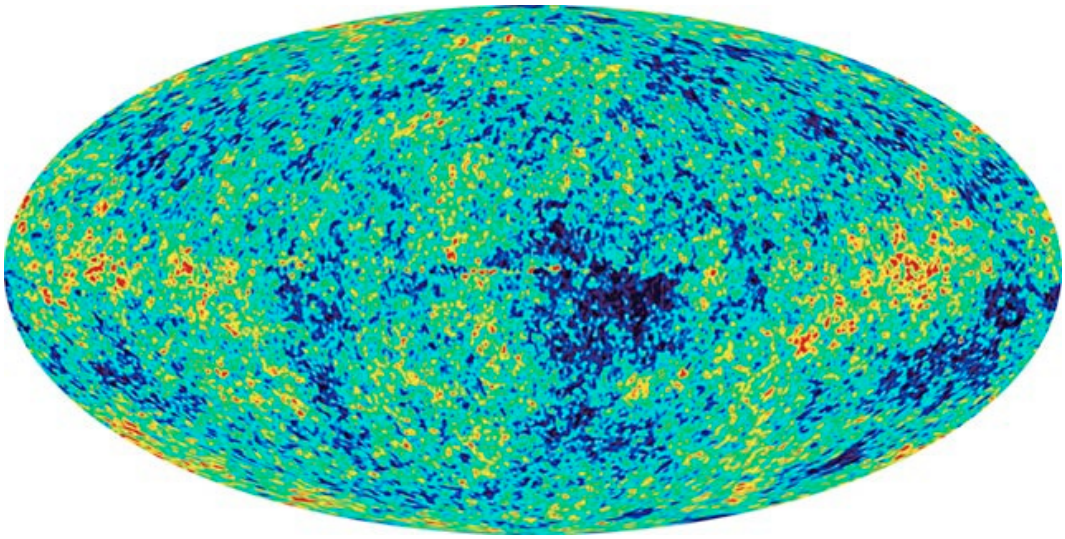


Figure 105. The First Detailed Full Sky Picture of the Oldest Light in the Universe. Credit: courtesy of NASA

Evidence of coherence in the Microwave Background is discussed in the following paper. Comments: Lectures presented at the NATO Advanced Studies Institute ``Structure Formation in the Universe'', Cambridge 1999. Authors: Andreas Albrecht. I review the current status of the theory of Cosmic Inflation. My discussion covers the motivation and implementation of the idea, as well as an analysis of recent successes and open questions. There is a special discussion of the physics of ``cosmic coherence'' in the primordial perturbations. The issue of coherence is at the heart of much of the success inflation theory has achieved at the hands of the new microwave background data.

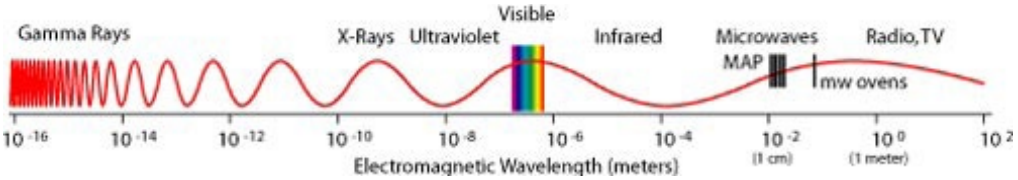


Figure 106. The light that is reaching us has been stretched out as the universe has stretched, so light that was once beyond gamma rays is now reaching us in the form of microwaves. Microwaves are the same as the light we see with our eyes, but stretched out to a longer wavelength. Credit: Courtesy of NASA.[377]

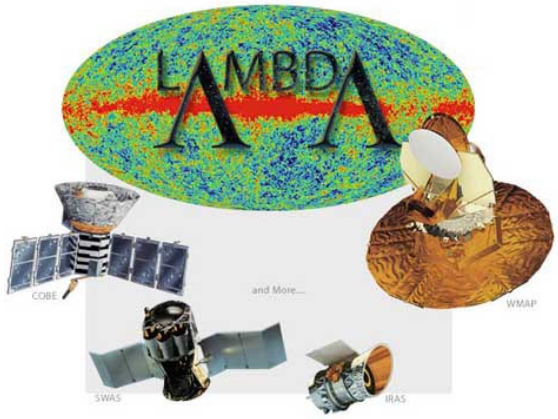


Figure 107. The science data for the WMAP (The Wilkinson Microwave Anisotropy Probe) mission is stored in a new on-line archive: the Legacy Archive for Microwave Background Data Analysis (LAMBDA). This site provides CMB (cosmic microwave background) researchers with archive data from NASA missions, software tools, and links to other sites of interest. Credit: courtesy of NASA[378]

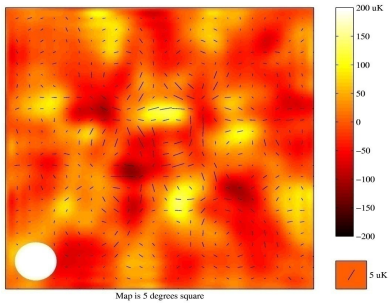


Figure 108. An image of the intensity and polarization of the cosmic microwave background radiation made with the Degree Angular Scale Interferometer (DASI) telescope. The small temperature variations of the cosmic microwave background are shown in false color, with yellow hot and red cold. The polarization at each spot in the image is shown by a black line. The length of the line shows the strength of the polarization and the orientation of the line indicates the direction in which the radiation is polarized. The size of the white spot in the lower left corner approximates the angular resolution of the DASI polarization observations... The polarization of the cosmic microwave background was produced by the scattering of cosmic light when it last interacted with matter, nearly 14 billion years ago... The polarization is a signpost from when the universe was only 400,000 years old, when matter and light were only just beginning to separate from one another.[379] Credit: Courtesy of NASA.

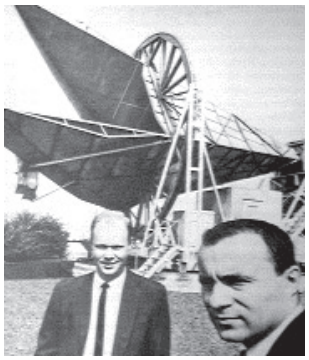


Figure 109. Penzias (right) and Wilson (left) near the horn antenna used to make their discovery (Courtesy of AT&T archives) of the Cosmic Microwave Background Radiation in Holmdel, New Jersey. This very-precise microwave laser preamplifier was used by Arno Penzias and Robert Wilson (1965) for astronomical research but was originally built by Bell Laboratories for the Telstar satellite communication experiments. After having eliminated all possible sources of noise (including pigeon droppings they nicknamed white-dielectric!) they discovered the 3 Kelvin black body cosmic background radiation. They later won the 1978 Nobel Prize in Physics for this discovery. Credit; courtesy of NASA[380]

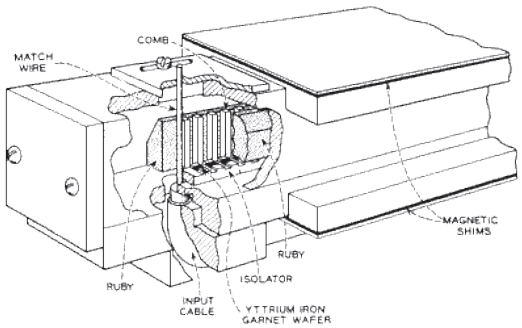


Figure 110. The Microwave Ruby Maser (Tabor and Sibilia, 1963) used by Penzias and Wilson (1965) to discover the 3 Kelvin microwave black body cosmic background radiation.

Placed within the horn-reflector (fig.97) is the Microwave Ruby Maser (fig.96)Tabor and Sibilia,(1963) used by Penzias and Wilson (1965) to discover the 3 Kelvin microwave black body cosmic background radiation. The Ruby Maser is the most sensitive amplifier ever made and today they are used in all of the giant radio telescope antennas used in astronomy and in the giant antennas in NASA's Deep Space Network (fig.98) that are used to receive signals and pictures from satellites visiting the planets in the solar system.[381] I am certain that just as the Microwave Ruby Maser led the Nobel prize winners to the oldest light of the universe so will our augmented visual faculty with the VRD, lead us to the recognition of our essential identity as rational human beings endowed with the scientific power to know Einstein's Laser Informed Vision of the Lambdasphere (the all-optical laser universe).

Vinton Gray "Vint" Cerf[1] (IPA: [s□f]; born June 23, 1943) is an American computer scientist who is the "person most often called 'the father of the Internet'."[2][4][5] His contributions have been recognized repeatedly, with honorary degrees and awards that

include the National Medal of Technology,[1] the Turing Award,[6] and the Presidential Medal of Freedom.[7] Cerf has worked for Google as its Vice President and Chief Internet Evangelist since September 2005.[3] In this role he has become well known for his predictions on how technology will affect future society, encompassing such areas as artificial intelligence, environmentalism, the advent of IPv6 and the transformation of the television industry and its delivery model.[8]…Cerf is also working on the Interplanetary Internet, together with NASA's Jet Propulsion Laboratory. It will be a new standard to communicate from planet to planet, using radio/ laser communications that are highly tolerant to signal degradation.[382][17]

Figure 111. The Deep Space Network, or DSN, is an international network of communication facilities that supports interplanetary spacecraft missions, and radio and radar astronomy observations for the exploration of the solar system and the universe. It is best known for its large radio antennas. The network also supports selected Earth-orbiting missions. DSN is part of the NASA Jet Propulsion Laboratory (JPL). Credit: courtesy of NASA

Einstein's Laser Informed Vision not only established our agenda for the future understanding of space-time, he also gave us the intellectual power to accomplish the mission of penetrating the foundation of the universe. With the advent of the terrestrial Laser Interferometer Gravitational Wave Observatory or LIGO[383] (fig.99) and the celestial Laser Interferometer pace Antenna or LISA[384] (fig.100) a new vision of the cosmos will emerge and the most accurate theory of the universe (the general theory of relativity) will be completely confirmed or surpassed. LIGO stands for Laser Interferometer Gravitational-Wave Observatory. Cofounded in 1992 by Kip Thorne and Ronald Drever of Caltech and Rainer Weiss of MIT, LIGO is a joint project between scientists at MIT and Caltech. It is sponsored by the National Science Foundation (NSF). At the cost of $365 million (in 2002 USD), it was the largest and most ambitious project ever funded by NSF[1] (and still is as of 2007). The international LIGO Scientific Collaboration (LSC) is a growing group of researchers, some 600 individuals at roughly 40 institutions, working to analyze the data from LIGO and other detectors, and working toward more sensitive future detectors.[385]

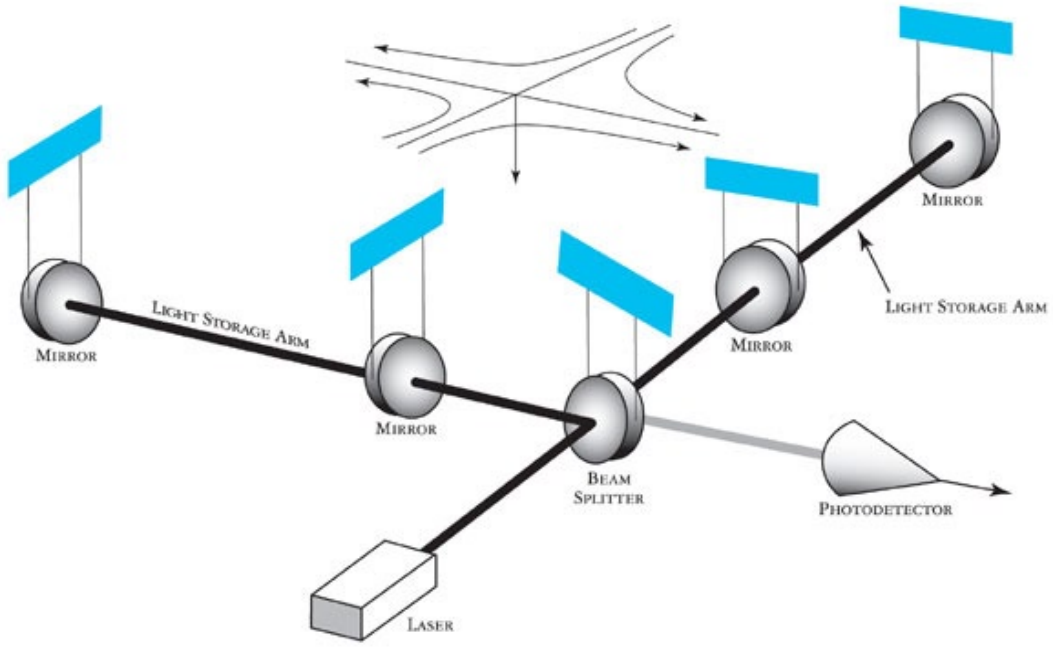


Figure 112. LIGO Detector The measurement is performed by bouncing high-power laser light beams back and forth between the test masses in each arm, and then interfering the two arms' beams with each other. The slight changes in test-mass distances throw the two arms' laser beams out of phase with each other, thereby disturbing their interference and revealing the form of the passing gravitational wave. Credit: courtesy of NASA.

The Laser Interferometer Space Antenna (LISA) is a mission that will detect and study gravitational waves coming from sources involving massive black holes and galactic binaries. As the first dedicated space-based gravitational wave observatory, LISA will detect waves generated by binaries within our Galaxy, the Milky Way, and by massive black holes in distant galaxies. Although gravitational wave searches in space have previously been made, they were conducted for short periods by planetary missions that had other primary science objectives. Some current missions are using microwave Doppler tracking to search for gravitational waves. However, LISA will use an advanced system of laser interferometry for detecting and measuring them. And, LISA will directly detect the existence of gravitational waves, rather than inferring it from the motion of celestial bodies, as has been done previously. Additionally, LISA will make its observations in a low-frequency band that ground-based detectors can't achieve. This difference in frequency bands makes LISA and ground detectors complementary rather than competitive. This range of frequencies is similar to the various types of wavelengths applied in astronomy, such as ultraviolet and infrared. Each provides different information.[386]

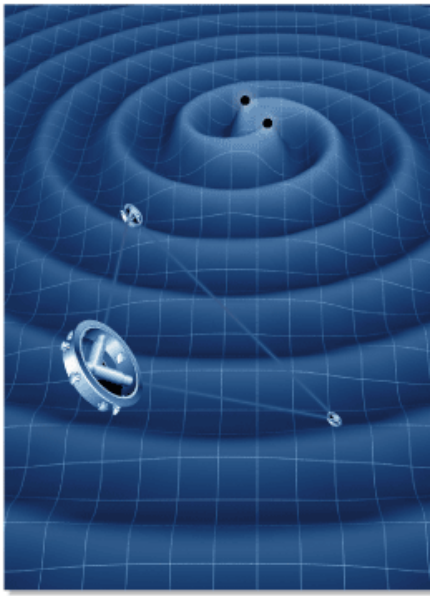


Figure 113. Credit; courtesy of NASA

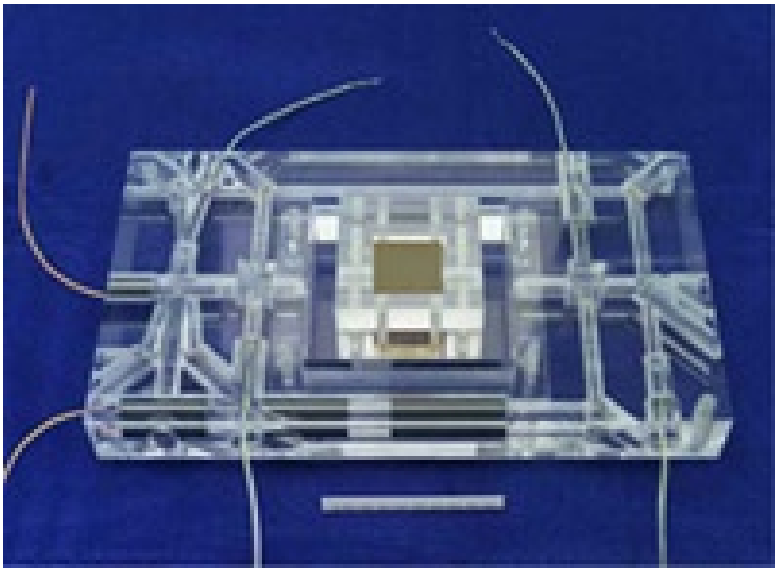


Figure 114. LISA Detector: The optical bench within each assembly contains the main optics: the laser beam injection, detection, and beam shaping optics, as well as the gravitational reference sensor. This bench consists of a solid glass block to which all components are rigidly attached. Credit: courtesy of NASA

2.5: Einstein's Laser Intelligence and the Lambdasphere

Figure 115. Famous "Blue Marble" photograph of Earth, taken from Apollo 17. Credit: courtesy of Wikipedia.

In 1884 at five years old Einstein lived in the town of Munich, Germany. Go to Google Earth Satellite or Windows Live and take a look at his home from outer space and ask yourself where am I looking from? Where am I going? These were the simple questions that Einstein asked himself during the development of his grand theory of relativity. Einstein was born with a memory problem for words. Kids with these problems have difficulties remembering words and so learning a language is very painful for them. However even though he had a difficult time learning to speak (he actually starting talking after he was 3 years old), his parents were very worried but nevertheless he was very intelligent visually. A visually intelligent kid is a kid who has a high degree of visual intelligence; all kids have intelligence of a different degree and type. According to Howard Gardner's theory of multiple intelligences you can see how Einstein's visual and laser intelligence is really an extension of his spatial intelligence.[387]

- Linguistic intelligence ("word smart"):
- Logical-mathematical intelligence ("number/reasoning smart")
- Spatial intelligence ("picture smart")→ Visual Intelligence→ Laser Intelligence
- Bodily-Kinesthetic intelligence ("body smart")
- Musical intelligence ("music smart")→ Emotional Intelligence
- Interpersonal intelligence ("people smart")→ Social Intelligence
- Intrapersonal intelligence ("self smart")
- Naturalist intelligence ("nature smart")

In its simplest sense being intelligent means you have the capacity to know and think about what you see, hear, touch, smell and taste. For example when you watch TV or play a video game you are using your visual or spatial intelligence, when you hear and understand what somebody is saying to you, you are using your verbal or linguistic intelligence, when you harmonize with music, you are using your emotional or musical intelligence etc.[388] A more holistic or integrated view of human intelligence is presented by Eric Kandel in his new synthesis of neuroscience. You can preview his book @ Google books: In Search of Memory: the Emergence of a New Science of Mind by Eric R. Kandel. "Charting the intellectual history of the emerging biology of mind, Eric R. Kandel illuminates how behavioral psychology, cognitive psychology, neuroscience, and molecular biology have converged into a powerful new science of mind. This science now provides nuanced insights into normal mental functioning and disease, and simultaneously opens pathways to more effective healing. Driven by vibrant curiosity, Kandel\'s personal quest to understand memory is threaded throughout this absorbing history. Beginning with his childhood in Nazi-occupied Vienna, In Search of Memory chronicles Kandel\'s outstanding career from his initial fascination with history and psychoanalysis to his groundbreaking work on the biological process of memory, which earned him the Nobel Prize. A deft mixture of memoir and history, modern biology and behavior, In Search of Memory traces how a brilliant scientist\'s intellectual journey intersected with one of the great scientific endeavors of the twentieth century: the search for the biological basis of memory."[389]

One day around 5 years old (figure 116), while Einstein was sick in bed his father gave him a compass. Now with compass in his

hand he started wondering and asking many questions; why is the needle always pointing north? What makes it do this? To answer these fundamental questions he spent the rest of his life investigating the laws of physics. His imagination was now highly stimulated as he started thinking about these wonderful forces of nature, like magnetism and electricity. His father owned a factory where they made street lights, so Einstein grew up playing with some of the electrical gadgets (magnets, coils and generated electricity) in his father's shop. But the compass (figure 117) was very inspiring to him because it directed his imagination in a very creative and visual way. Einstein once said that "I can still remember—or at least I believe I can remember—that this experience made a deep and lasting impression on me… Something deeply hidden had to be behind things."[390]Thanks to geoscience we are now able to actually see what is deeply hidden in the magnetic compass. "As seen below (fig.118), the Earth's core is thought to consist largely of molten iron (red). But at the very core, the pressure is so great that this super hot iron crystallizes into a solid.[391] Convection (atmospheric transfer or transmission) caused by heat radiating from the core, along with the rotation of the Earth, causes the liquid iron to move in a rotational pattern. It is believed that these rotational forces in the liquid iron layer lead to weak magnetic forces around the axis of spin (figure 119). The magnetic needle on the compass detects these weak magnetic forces. It is important to be aware that these geo-magnetic forces actually come from the sun and are filtered through the magnetosphere (figure 120) and penetrate the Earth's core." [392]

By applying the laser as a drill, a Thermal Fracture Technique (figure 121)[393] along with its conversion and amplification power in combination with the Venus Project's design (figures 122-124) for the Open Resource Based Economy we can extract the full potential of the geothermal power (figure 125) that is radiating from the core of the Earth. According to Wikipedia; "A 2006 report by MIT, that took into account the use of Enhanced Geothermal Systems (EGS), concluded that it would be affordable to generate 100 GWe (gigawatts of electricity) or more by 2050 in the United States alone, for a maximum investment of 1 billion US dollars in research and development over 15 years.[9]The MIT report calculated the world's total EGS resources to be over 13,000 ZJ (zettajoule or 1021 J). Of these, over 200 ZJ would be extractable, with the potential to increase this to over 2,000 ZJ with technology improvements - sufficient to provide the entire world's present energy needs for several millennia.[9]The key characteristic of an EGS (also called a Hot Dry Rock system), is that it reaches at least 10 km down into hard rock. At a typical site two holes would be bored and the deep rock between them fractured. Water would be pumped down one and steam would come up the other. The MIT report estimated that there was enough energy in hard rocks 10 km below the United States to supply all the world's current needs for 30,000 years."[9]394

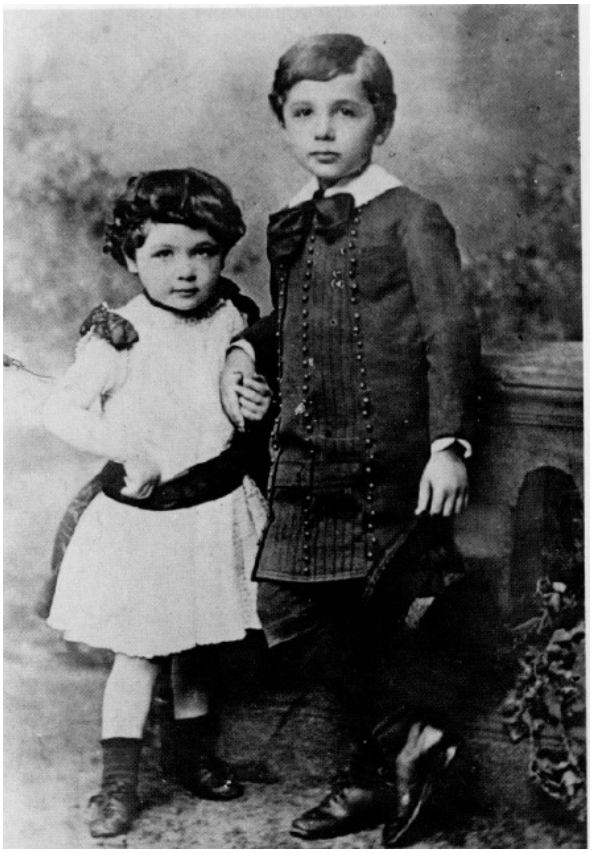


Figure 116. Einstein at 5 with his little sister Maja in 1884. "Imagination is more important than knowledge; knowledge is limited, whereas imagination encircles the world, stimulating progress, giving birth to evolution." Credit courtesy of Einstein Archives Online. [395]

Figure 117. A compass (or mariner compass) is a navigational instrument for finding directions on the Earth. It consists of a magnetized pointer free to align itself accurately with Earth's magnetic field, which is of great assistance in navigation. The face of the compass generally highlights the cardinal points of north, south, east and west. A compass can be used (to calculate heading) in conjunction with a marine chronometer (to calculate longitude) and a sextant (to calculate latitude) to provide a somewhat accurate navigation capability. This device greatly improved maritime trade by making travel safer and more efficient. Credit: courtesy of Wikipedia.[396]

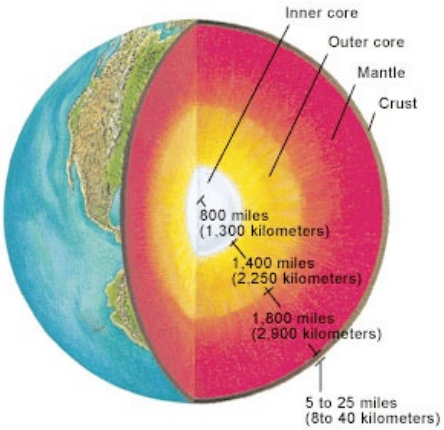


Figure 118. Beneath Earth's solid crust are the mantle, the outer core, and the inner core. Scientists learn about the inside of Earth by studying how waves from earthquakes travel through the planet. Image credit: World Book illustration by Raymond Perlman and Steven Brayfield, Artisan-Chicago. Credit; courtesy of NASA

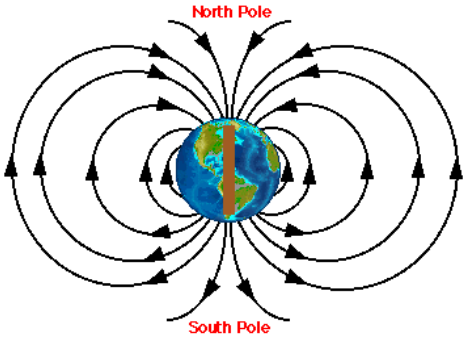
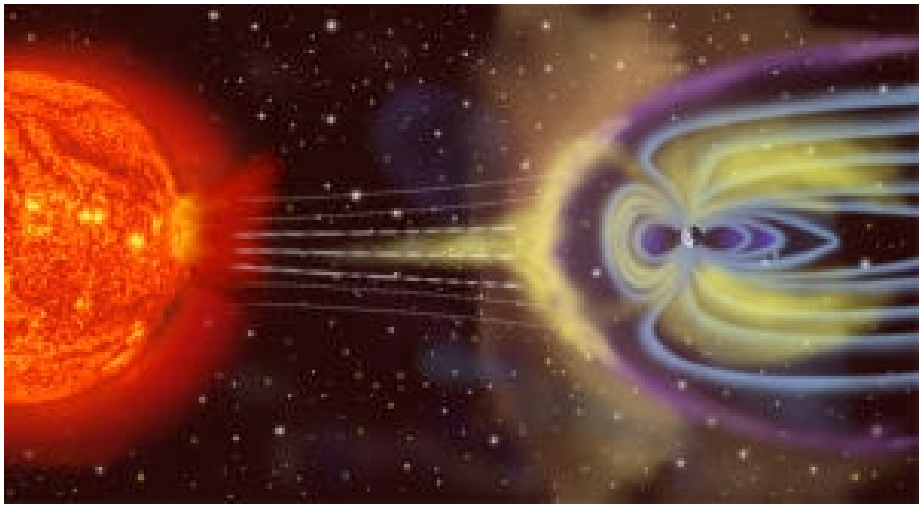


Figure 119.The figure shows a schematic of the Earth's magnetic field visualized through field lines. In the real world the magnetic axis between the magnetic North and South Poles does not coincide with the axis of rotation exactly, so the actual magnetic field is slightly turned with respect to the axis of rotation. The effect is very small and varies with time. The same magnetic field can be produced if the Earth is replaced by a giant bar magnet as shown. Credit: courtesy of NASA



,Figure 120. The magnetosphere shields the surface of the Earth from the charged particles of the solar wind. It is compressed on the day (Sun) side due to the force of the arriving particles, and extended on the night side. Credit: courtesy of Wikipedia. [397,]

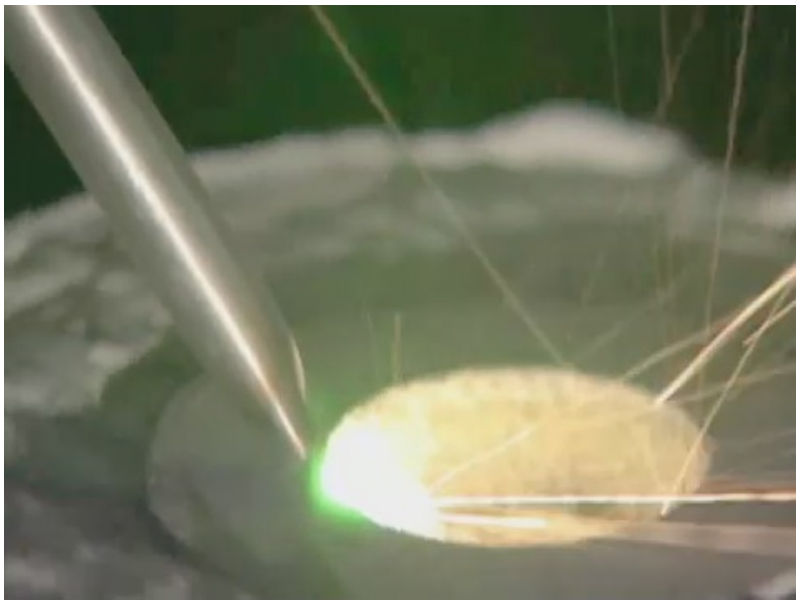


Figure 120. Laser Thermal Fracture Technique penetrates to the Core of the Earth @ The Argonne National Laboratory. ANL at the University of Chicago is one of the U.S. Department of Energy's largest research centers. It is also the nation's first national laboratory, chartered in 1946. Credit: History Channel Special on Laser Drilling

Figure 121. Geothermal Energy, as refinements in conversion technologies increase its feasibility, geothermal energy will come to take on a more prominent role. Readily available in various geographical regions throughout the world, both on land and under the sea, this energy source alone could provide enough clean energy for the next thousand years. Credit courtesy of the TVP.

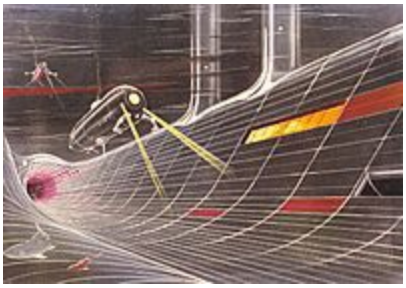


Figure 122. Underwater Turbines, these underwater structures are designed to convert a portion of the flow of the Gulf Stream through turbines to generate clean electric power. These slow rotating turbines would have a centrifugal separator and deflectors to prevent harm to marine life. Credit courtesy of the TVP

Figure 123. Bering Strait Dam, a land bridge or tunnel might be constructed across the Bering Strait. The primary function of this span would be to generate electrical power and house facilities for collecting and processing marine products. Beneath and above the ocean surface would be tunnels for the transport of both passengers and freight. Not only could this structure provide a physical link between Asia and North America, it could also serve as an avenue for social and cultural exchange. This land bridge would perhaps serve as a base for the development of clean fusion power. Pipelines to conduct fresh water from melting icebergs to other parts of the world may also be incorporated. Credit courtesy of the TVP[398]

Laser drilled Geothermal Energy for the Photonics Powerline Home Network.

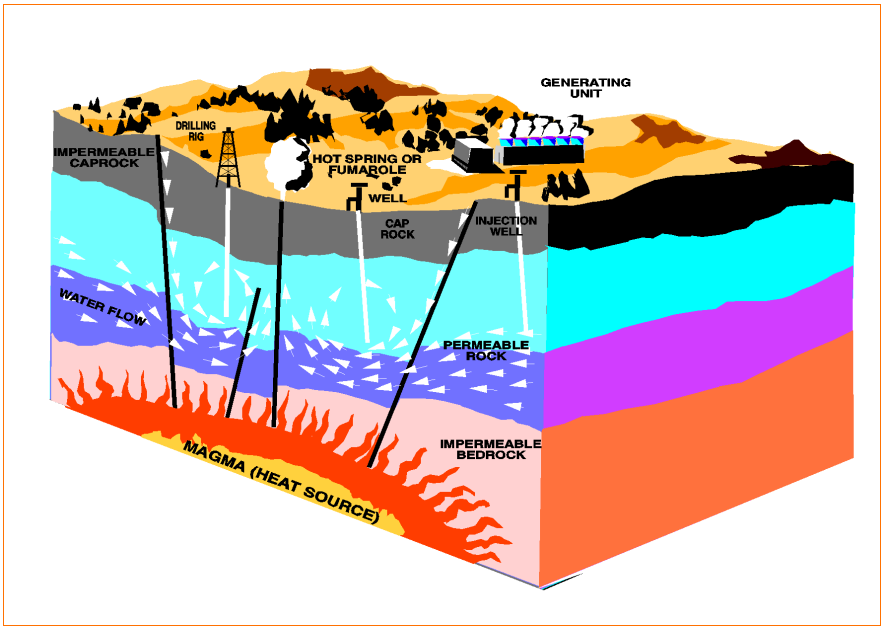


Figure 124. Geothermal power (from the Greek roots geo, meaning earth, and therme, meaning heat) is energy generated by heat stored in the earth, or the collection of absorbed heat derived from underground, in the atmosphere and oceans. Prince Piero Ginori Conti tested the first geothermal generator on 4 July 1904, at the Larderello dry steam field in Italy.[1] The largest group of geothermal power plants in the world is located in The Geysers, a geothermal field in California.[2] As of 2008, geothermal power supplies less than 1% of the world's energy…[3] The MIT report calculated the world's total Enhanced Geothermal Systems (EGS) resources to be over 13,000 ZJ. (1021 J ZJ zettajoule).[399] Of these, over 200 ZJ would be extractable, with the potential to increase this to over 2,000 ZJ with technology improvements - sufficient to provide all the world's present energy needs for several millennia.[9] Credit: Courtesy of Wikipedia.[400]

This Wikipedia page lists examples of the Orders of magnitude (power in watts) produced by various different sources of energy. They are grouped by orders of magnitude, and each section covers three orders of magnitude, or a factor of one thousand.

- 1 Below 1 Watt
  - 1.1 yoctowatt (10^{-24} watt)
  - 1.2 zeptowatt (10^{-21} watt)
  - 1.3 attowatt (10^{-18} watt)
  - 1.4 femtowatt (10^{-15} watt)
  - 1.5 picowatt (10^{-12} watt)
  - 1.6 nanowatt (10^{-9} watt)
  - 1.7 microwatt (10^{-6} watt)
  - 1.8 milliwatt (10^{-3} watt)
- 2 Between 1 and 1000 Watts
  - 2.1 watt
- 3 Above 1000 Watts
  - 3.1 kilowatt (10^{3} watts)
  - 3.2 megawatt (10^{6} watts)
  - 3.3 gigawatt (10^{9} watts)
  - 3.4 terawatt (10^{12} watts)
  - 3.5 petawatt (10^{15} watts)
  - 3.6 exawatt (10^{18} watts)
  - **3.7 zettawatt (10^{21} watts)**
  - 3.8 yottawatt (10^{24} watts)
  - 3.9 greater than one yottawatt

Solution to all our energy needs. Laser drilled geothermal power. It's cheaper than coal! By Josh S

"In the past geothermal power plants could only be located where there were preexisting geological conditions, such as a geyser or a hot spring. It also used to be the norm to use drill bits to drill oil and gas wells. Now high powered lasers are used to do the drilling, and the drilling can be done 10 to 100 times faster without any time or money wasted on changing drill bits.

It's now possible to drill a hole VERY deep into the earth using lasers, almost to the point that you hit lava! By doing this you can then *create* a geological condition that allows a geothermal power plant... anywhere you choose to :) There are several methods, but I propose using a set of two pipes that are insulated with "Aerogel" (Aerogel is the world's best thermal insulator) most of the way, to keep the steam's heat from leaking back into the cold earth on the way back up. Cold water, or some other fluid, is then pumped in and it exits as steam that can be used to drive a turbine. It's MUCH cheaper than solar power. It's even cheaper than coal power! To build a coal power plant, you must build a rather large facility, pay for coal and pay for shipping the coal, and last but not least: you need to buy a turbine.With laser drilled geothermal power you simply drill a hole, drop in the pipes, and then hook up the turbine to the pipes. So obviously it's cheaper to construct than a coal power plant and it's certainly cheaper to operate! It doesn't require ANY fuel. It's 100% renewable energy, it pumps out energy day and night, in all weather, potentially for hundreds of years!

Best of all, one big laser can be used to drill holes and then move on to the next hole. The only real cost associated with these power plants is the cost of piping and the turbines! In theory it shouldn't be possible to find any cheaper energy source, especially when you factor in the cost of operation.

Since numerous holes can be dug fairly close to one another, dozens and dozens of big turbines can be housed in one facility... meaning they can easily produce more power than a nuclear power plant, without any risk of meltdown, or problems with waste disposal or nuclear proliferation/terrorism. Laser drilled geothermal power is "Natures nuclear power" since the warmth of the Earth's core comes from very deep radioactive decay.

There is a company called Geoternity that plans on doing just this. I don't work for them or anything I just find their stated goals very interesting.

MIT has recently written about it and said that it can cost about half as much as coal, and provide 100% of our required energy for future generations, if we'll just take the leap and build the damned things.

The main problem is that not too many people seem to know about this. If *you* tell people and urge them to tell people, and there is eventually public demand, then it can get funding and get off the ground. If it remains in the dark, it could be delayed for who knows how long. I've heard some say this "might be done in the far future". WHY NOT NOW!? The technology exists and it's cheaper than coal!

What I find most interesting about these new laser drilling methods is that underground housing can be carved out of the bedrock, then manmade geothermal power plants can be used to ventilate, control climate, clean water, provide lighting, etc. I'll bet the Write brothers sounded crazy when they described human flight, but this is possible...

I've heard many say that the Earth is becoming overpopulated, and that sustainability is becoming a problem. Why not build cities under the ground of the searing hot "uninhabitable" deserts of the world? They already make shopping malls that are underground, Why not build cities beneath the shallow ocean seabed? For that matter, why not underneath Antarctica's bedrock? The cities can be connected with laser drilled tunnels for subway trains.

A: It would expand our inhabitable area without further damaging the environment, allowing a larger potential sustainable population.

B: It would allow us to live without the sun if need be, even allowing underground greenhouses for agriculture. In case there were ever an asteroid impact or a nuclear winter, or ice age due to climate change, we'd be prepared and able to survive.

C: It would prepare us for colonizing Mars. If we can live in cities under

Antarctica, then why not Mars? Mars has geothermal power to be tapped'...[401]

In the second half of the 20th century the development of Einstein's electro-magnetic knowledge and E= MC2 directed scientist to the magnetic confinement approach to fusion power. (Figures 126-128) "The Joint European Torus (JET), at Culham in the United Kingdom, and the Tokomak Fusion Test Reactor (TFTR), at Princeton in the United States, have produced more than 10 MW (albeit for only a few seconds), showing that fusion can work in practice. The next step will be to construct a power-plant-size device called the international Thermonuclear Experimental Reactor (ITER), which will produce 500 MW for up to 10 minutes, thereby confirming that it is possible to build a full-size fusion power plant.[402] The development of fusion energy is a response to a global need, and it is expected that ITER will be built by a global collaboration."[403] This global expectation of collaboration has finally consolidated in 2006 thanks to a global agreement between the USA, EUROPE, RUSSIA, CHINA and JAPAN, INDIA, KOREA. The global concentration of our laser intelligence on this project will make it a reality real quickly. ITER is an international tokomak (magnetic confinement fusion) experiment, planned to be built in France and designed to show the scientific and technological feasibility of a full-scale fusion power reactor. It builds upon research conducted on devices such as TFTR, JET, JT-60, and T-15, and will be considerably larger than any of them. The program is anticipated to last for 30 years—10 years for construction, and 20 years of operation—and cost approximately €10 billion ($12.1 billion). After many years of deliberation, the participants announced in June, 2005 that ITER will be built in Cadarache, France. DEMO is a proposed experimental nuclear fusion reactor. It will build upon the research that is to be conducted by ITER,[404] only that it will be at the scale of a commercial reactor. It may or may not generate electricity for a public grid, depending on its success… 2005 – Following final negotiations between the EU and Japan, ITER chose Cadarache over Rokkasho for the site of the reactor. In concession, Japan was made the host site for a related materials research facility and was granted rights to fill 20% of the project's research posts while providing 10% of the funding.[405]

Figure 125. The world's largest nuclear fusion research facility. ET's unique features allow us to explore the unknown; to investigate fusion's potential as a safe, clean and virtually limitless energy source for future generations. Situated at Culham in the UK, the **J**oint **E**uropean **T**orus is run as collaboration between all European fusion organizations and with the participation of scientists from around the globe. Courtesy of EFDA-JET.org.[406]

Figure 126. Credit: courtesy of ITER.org

Figure 127. Credit: courtesy of ITER.org

Einstein's laser intelligence is also helping NASA scientist understand how the aurora borealis (North Pole) and australis (South Pole) in the geomagnetic sphere (figure 129) actually works. They sent a satellite called the Fast Auroral Snapshot Explorer (FAST figure 130)) to help them visualize what I call the Lambdasphere (the laser/maser phenomena in the geomagnetic sphere). The instruments aboard FAST measure charged particles which enter Earth's upper atmosphere; large waves of these particles from the sun begin to glow once inside Earth's atmosphere causing a spectacular light show known as the Aurora Borealis or Northern Lights. An invisible aurora exists as a companion to the familiar visible aurora, also known as the aurora borealis, or northern lights, in the Northern Hemisphere and the aurora australis (southern lights) in the Southern Hemisphere. Researchers using NASA's Fast Auroral Snapshot (FAST) spacecraft established the presence of the invisible aurora by consistently detecting upward flows of electrons interspersed with the downward flowing electrons that produce the visible aurora.

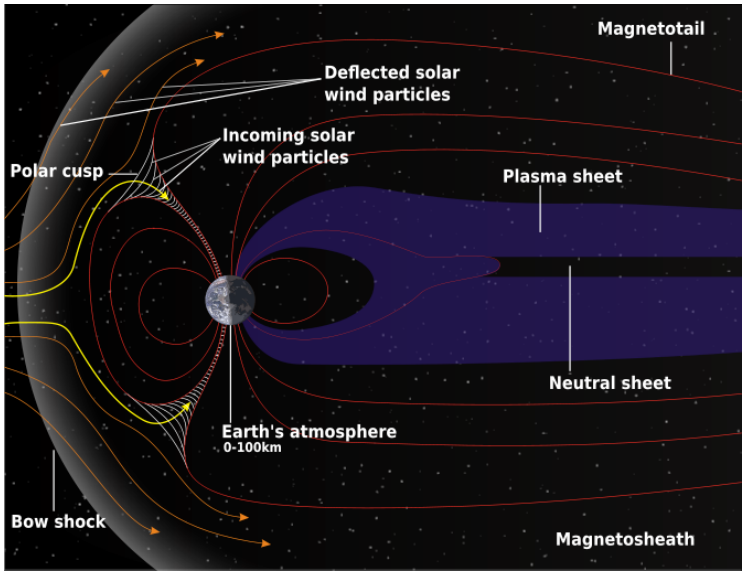


Figure 128. Schematic of Earth's magnetosphere, the solar wind flows from left to right. Credit: courtesy of Wikipedia

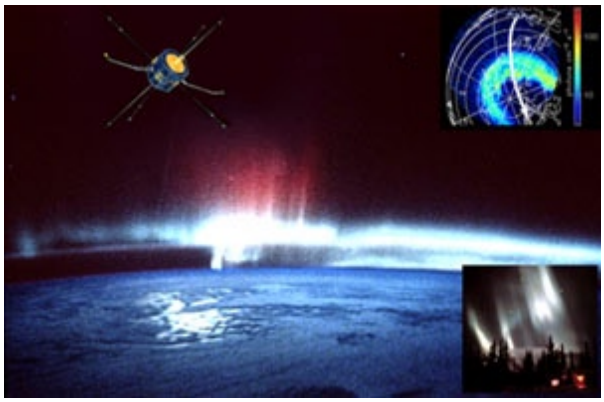


Figure 129. The Fast Auroral Snapshot Explorer (FAST) was launched from Vandenberg Air Force Base on board a Pegasus XL rocket on August 21, 1996. One in the series of NASA's Small Explorer (SMEX) spacecraft, FAST was designed to observe and measure the plasma physics of the auroral phenomena which occur around both poles of the Earth. It is operated by the University of California, Berkeley's Space Sciences Laboratory. Credit: courtesy of Wikipedia.[407]

The discovery provides the first detailed picture of how the aurora and its inverted companion function together to complete a huge electric circuit in the magnetosphere, which is that region of space where electrically charged particles are controlled by the Earth's intrinsic magnetic field. The spacecraft's passages through the electrified auroral regions also provide the best explanation yet as to how they turn the Earth into a giant radio transmitter capable of broadcasting billions of Watts of high frequency radio waves into space. The theory grants new insight into how natural radio emissions are generated throughout the solar system and the cosmos. "Researchers had some previous indicators that the invisible aurora existed, but earlier spacecraft provided only isolated observations of its presence," said Dr. Robert Pfaff, FAST Project Scientist at NASA's Goddard Space Flight Center, Greenbelt, Md. "The FAST results establish such upward-moving electrons as consistent, regular features of the aurora." Visible auroras occur when electrons are accelerated by electric fields in the Earth's magnetosphere down along the nearly vertical magnetic field lines of the Polar Regions, into the upper atmosphere. Auroral light is emitted when the energetic electrons collide with the neutral atmosphere, about 60-180 miles (100-300 kilometers) above the Earth's surface. They create haunting, multicolored displays as they crash into atmospheric particles, often appearing as shifting curtains of light from the ground. The invisible magnetic field lines converge as they approach the Earth's upper atmosphere at the Polar Regions, forming a funnel or nozzle shape. FAST data have established that electric fields oriented parallel to these magnetic field lines accelerate the auroral electrons, in much the same way as water is accelerated when passing through a nozzle.

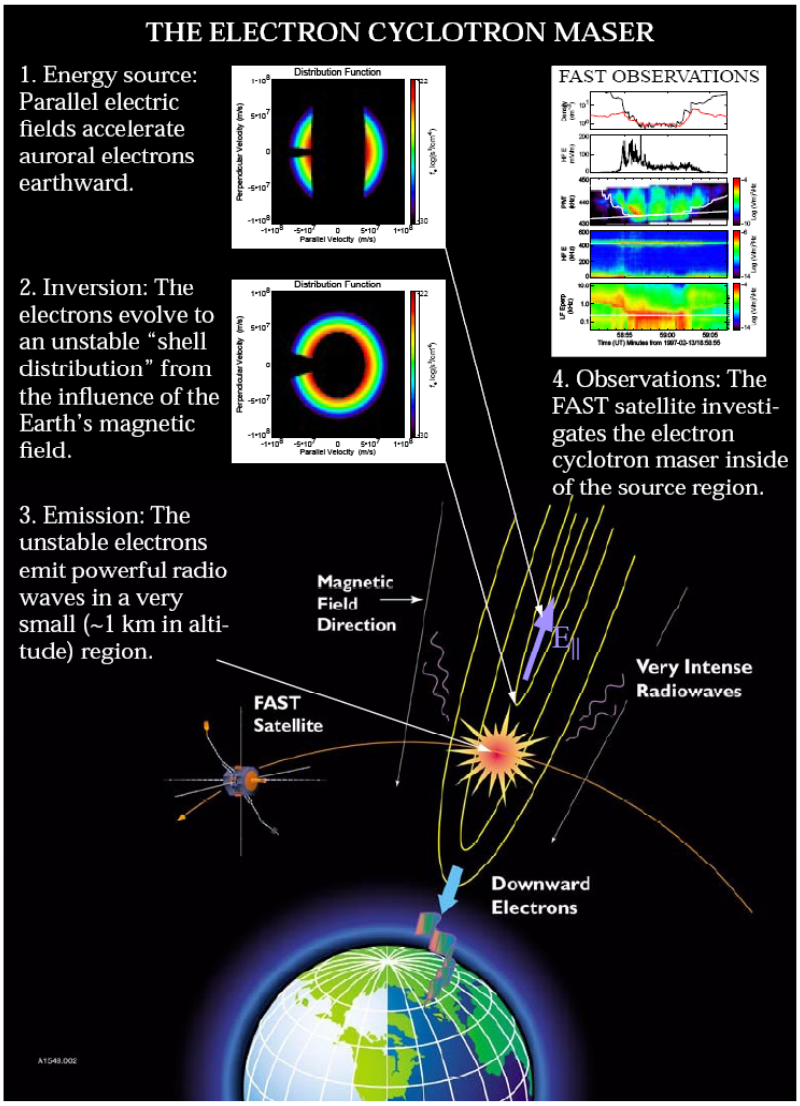


Figure 130. FAST SPACECRAFT DISCOVERS INVISIBLE AURORA. FAST view of invisible parallell electric fields producing visible aurara structure. Credit courtesy of NASA.

The idea of parallel electric fields was proposed over 50 years ago by Nobel laureate, Hans Alfvén of Sweden. Although ridiculed at the time as electric fields directed this way were believed to "short out" when oriented along the highly conducting magnetic field lines, observations gathered in space, such as those from the FAST satellite, as well as recent theoretical advances, have clearly shown that such processes produce the aurora and may indeed be widespread in nature. Furthermore, the FAST data show that the directions of such electric fields are reversed in cases where they accelerate electrons up out of the ionosphere to produce the newly discovered invisible aurora. This new type of aurora, also known as the inverse or black aurora, is invisible because the accelerated electrons are above most of the faint, upper atmosphere by the time they reach speeds that are sufficient to allow the atmospheric atoms and molecules to glow via collisions with the electrons. In this fashion, the upward-moving electrons complete the electrical circuit returning current to the distant magnetosphere The controversial parallel electric fields are also directly linked to intense radio emission from the auroral regions, called Auroral Kilometric Radiation, according to new observations from FAST. The parallel electric fields power a process that generates the radio emission, called the Electron Cyclotron Maser, which is like a natural laser except at radio frequencies

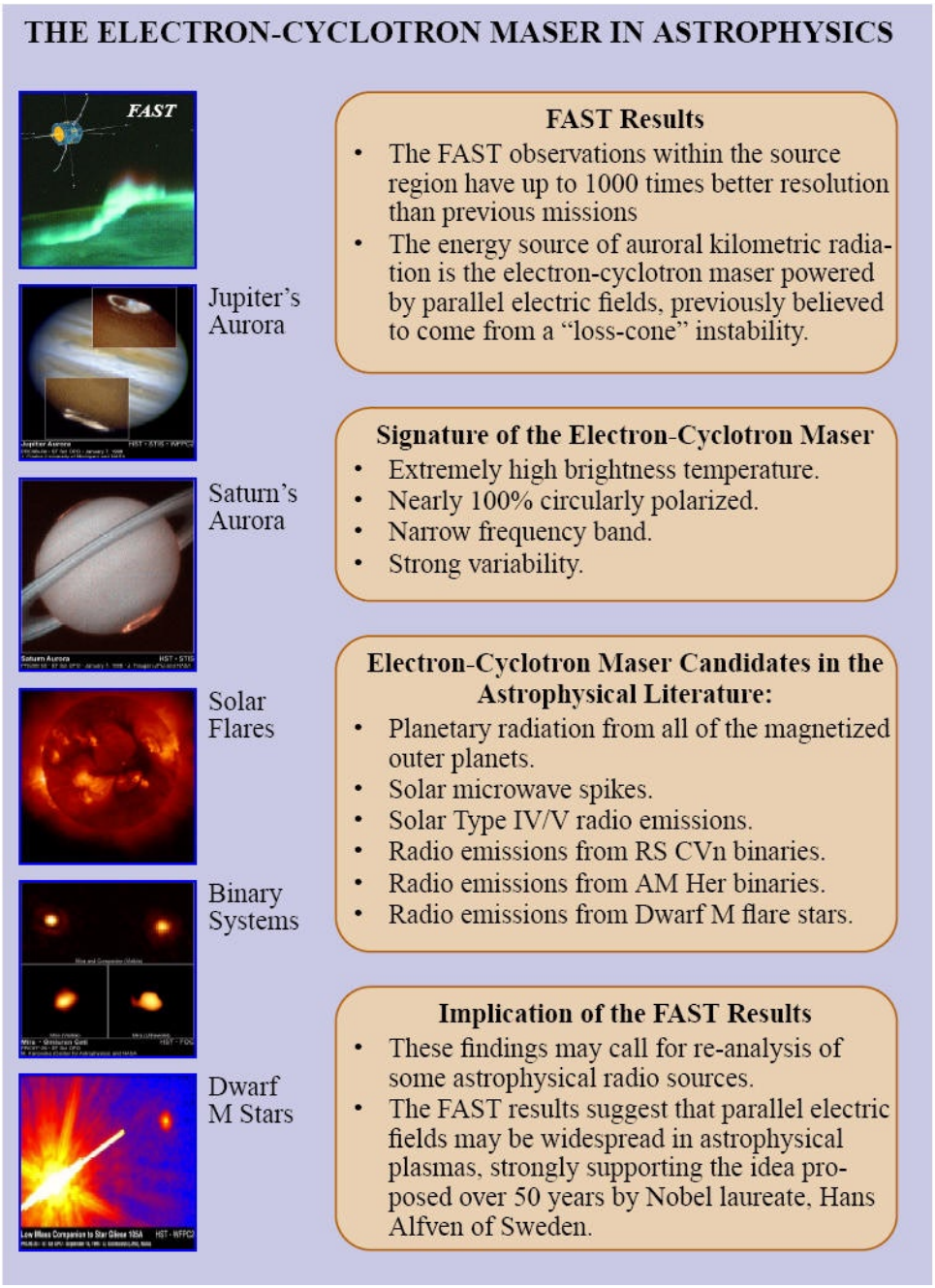


Figure 131. Credit courtesy of NASA.

This powerful radio emission, generally at several hundred kilohertz to a few megahertz, is not detected on the ground because it is blocked by the Earth's upper atmosphere (ionosphere). Several decades of observations by other spacecraft, as well as from radio telescopes, have detected similar emissions emanating from other planets such as Jupiter and Saturn, as well as from electrically charged gas (plasma) throughout the Universe. "This radio emission is observed throughout the Universe by radio astronomers," said Dr. Robert Ergun, an astrophysics professor at the University of Colorado. "It's a fundamental process that occurs in many stars and planets, so understanding how these radio waves are generated is important to understanding how the Universe works. Many theories have been proposed to explain it, but so far, observations have been inadequate to resolve the issues. The new data from FAST is changing that."Key to the discoveries is the new, high-resolution electrostatic detectors aboard FAST called "Top Hats". Designed and built by Dr. Charles Carlson at the University of California, Berkeley, such top hat detectors can sample incoming electrons over a 360-degree field of view with unprecedented time resolution of just a few milliseconds for a complete distribution. Unlike earlier detectors with a limited field of view, the FAST energetic particle detectors can continuously sample rapidly moving electrically charged particles in all directions, independent of the satellite's spin. Dr. Carlson is also the Principal Investigator for the FAST spacecraft.[408] One extremely important consequence of the cavity is the generation of Auroral Kilometric Radiation by the electron cyclotron maser mechanism. This mechanism requires both the low density cavity for the maser mechanism to work, and the energetic electron beam which supplies the energy source."[409] Auroral Plasma Physics is the study that describes how the ionic or electrically charged gas (4th state of matter after solid, liquid, and gas) generate the coherent light or 5th state of matter in the aurora borealis and australis.[410]The key function of the magneto sphere as you know is to protect the Earth from the powerful solar winds, without it no life would be possible on Earth. The Laser as it turned out is the geomagnetic light that converts the disordered light rays of the sun into the ordered waves of the auroras and thereby protects the process of photosynthesis, allowing for life to flourish on our precious planet.

Figure 132. .The Aurora Borealis shines above Bear Lake. Auroras (Polar Lights; or aurorae, sing.: aurora) are natural colored light displays, which are usually observed in the night sky, particularly in the polar zone. Some scientists call them "polar auroras" (or "aurorae polares"). In northern latitudes, it is known as the aurora borealis, named after the Roman goddess of dawn, Aurora, and the Greek name for north wind, Boreas. It often appears as a greenish glow (or sometimes a faint red), as if the sun were rising from an unusual direction. The aurora borealis is also called the northern polar lights, as it is only visible in the North sky from the Northern Hemisphere. The aurora borealis most often occurs from September to October and from March to April.Its southern counterpart, the aurora australis/southern polar lights, has similar properties. Australis is the Latin word for "of the South". Credit: courtesy of Wikipedia.[411]

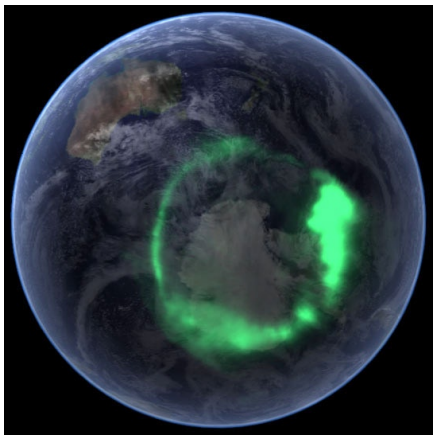


Figure 132. Aurora australis (September 11, 2005) as captured by NASA's IMAGE satellite digitally overlaid onto the Blue Marble composite image. Credit: courtesy of Wikipedia.

Figure 133. FAST is probing the physical processes that produce auroras, the displays of light that appear in the upper atmosphere at high latitudes. FAST discovered the invisible MASER that produces the visible Aurora (oxygen laser). Credit: courtesy of NASA[412]

According to George Gilder "Einstein's vision of stimulated light differentiates it clearly from all other light we see... The above pictures (figures 126-132) is an example of how Einstein's law of Stimulated Emission Radiation "works in nature in the phenomena known as the aurora borealis or Northern Lights, which in effect are a vast oxygen laser, excited by unusually intense discharges from the sun. Stimulated, coherent light defies the forces of entropy and equilibrium that tend to pull atoms to their lowest available energy state. The opposite of lasing is laziness--the principle of least action--a fundamental law of nature discovered by the nineteenth-century Irish physicist William Hamilton. As Hamilton noticed, most particles, most of the time, are inert. To stimulate light, by contrast, you must pump up the crowds--pump up electrons into an excited state faster than they tumble to ground, and then watch the transcendent light pour forth into the telecosm."[413] The discovery of the coherent generation of waves on the geomagnetic fields via the FAST satellite coupled to the new optical links between satellites using lasers and the all-optical laser internet will give mankind full access and control of the coherent universe. George Gilder, in his great book: Telecosm, How Infinite Bandwidth will Revolutionize our World[414], discusses the Lambdasphere, the global laser and fiber-optic network across which all data and information is currently being delivered. He believes that the 7-layer networking protocol of today will collapse into just the physical laser transport layer. Laser light will be the source of all information transfer using technologies such as Wave Division Multiplexing and non-linear optical chips. My LaserEmpowered vision postulates that Microvision's VRD has the potential to replace the most pervasive display device of today - the computer monitor. I believe that methods are being developed to connect directly to the essence of the Lambdasphere, processing the coherent light directly into the brain. Microvision's VRD is the new device on the edge of the network that gives us a direct connection to the "Coherent Global Brain," which is the internet. The purification of our vision coupled to this cognitive enhancement via the VRD will enable us to understand and practice Einstein's LaserEmpowered Vision.

Figure 134. Laser beams message between satellites,[415] this artist's impression shows the ARTEMIS satellite using a laser link to communicate with another satellite These two satellites have become the first to exchange information from different orbits using a laser. The feat may lead to super-fast data-relay systems between spacecraft.[416] Credit: Image: European Space Agency ESA.

Free-Space Optics (FSO) is a line-of-sight technology that uses lasers to provide optical bandwidth connections. Currently, FSO is capable of up to 2.5 Gbps (Giga bytes per second) but can be increased to 10 Gbps using WDM (wave division multiplexing) of data, voice and video communications through the air, allowing optical connectivity without requiring fiber-optic cable or securing spectrum licenses. FSO requires light, which can be focused by using either light emitting diodes (LEDs) or lasers (light amplification by stimulated emission of radiation). The use of lasers is a simple concept similar to optical transmissions using fiber-optic cables; the only difference is the medium. Light travels through air faster than it does through glass, so it is fair to classify FSO as optical communications at the speed of light. [417] TeraBeam Inc. a producer of Free Space Optics "consummates--according to Gilder--the telecosm, extending the magic of light wave communications to the wireless domain. Moving all the way up Maxwell's rainbow to the edge of the domains of visible light, Terabeam's terabits are on their way toward a location near you. An ingenious new point-multipoint technology that can serve many users at once from one antenna, it closes the last mile gap between the wavelength division multiplexed floods of fiber and your computers. (Telecosm, How Infinite Bandwidth Will Revolutionize Our World p.232 (September 2000)[418]… Gilder says that "creating end-to-end connections, the network would link the world over myriad colors of light in much the way that the voice network connected billions of customers over analogue carriers on myriad copper wires. First introduced to me in the late 80s by Will Hicks, the co-inventor (with Elias Snitzer) of the single mode fiber, the concept of the lambda based network—with every terminal eventually bearing a wavelength address—provided an ultimate standard by which to gauge progress in the industry. For most of the decade, however, this vision remained in the shadows of an awesome campaign by the fiber optics industry for expanded bandwidth, measured first in megabits, then gigabits, and now in terabits per second, first over tens, then over hundreds, then over thousands of kilometers. Focusing on point-to-point connections, mostly in the backbone trunks of the system, this drive has succeeded beyond all expectations. As I have often pointed out, the industry now knows how to put not terabits but petabits (ten to the 15th or thousands of millions of millions of bits per second) on a single fiber. This capacity per second is close to the total Internet traffic per month in recent years (some estimates show a petabyte per month in 1999)."[419]

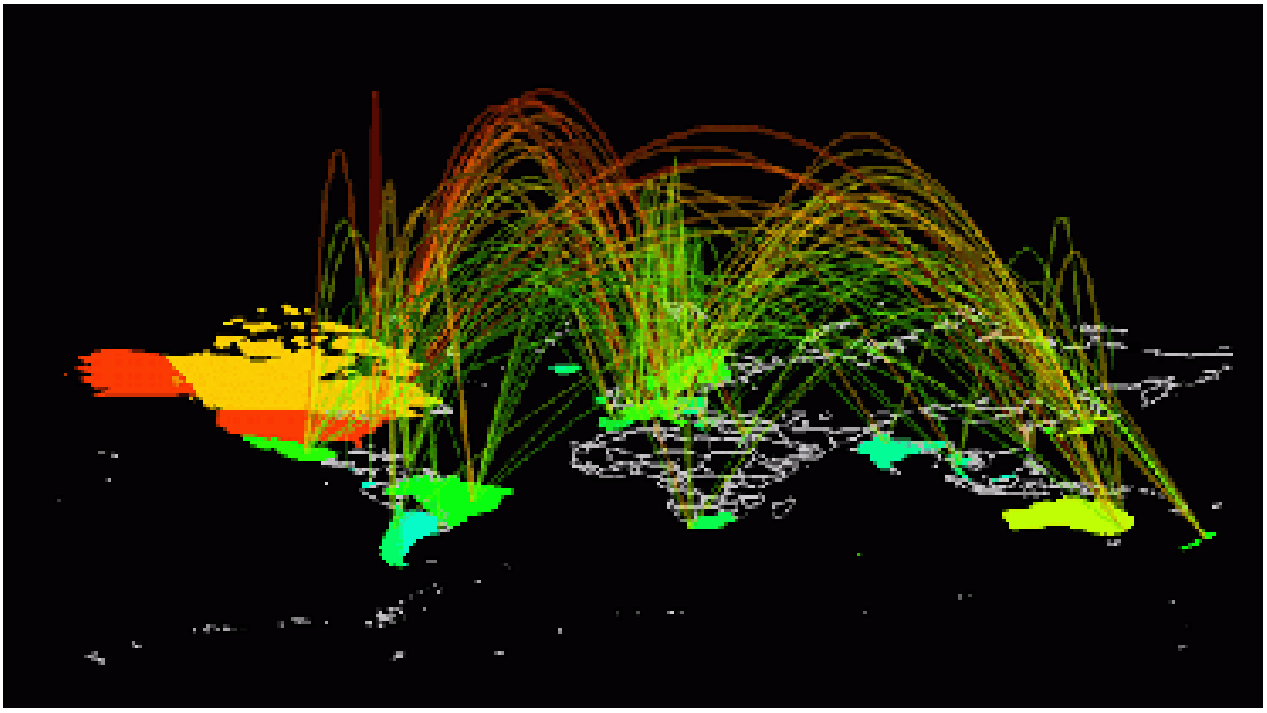


Figure 135. Free Space Optics Credit:. Courtesy of Lucent Technologies

Today as of 2008 over one billion kilometers of fiber-optic cable encircles the earth establishing our civilization's global brain and central nervous system. Gilder predicts a zettabyte (1021 bytes) of U.S. Internet traffic by the year 2015. 100-gigabyte-per-second traffic over fiber is now a reality, but the private carriers are barely giving the US user about 1 to 2 megabits per second bandwidth.[420] The public will have to fund and take full control of the telecom infrastructure if we are to access the full capacity of the internet! "Imagine gazing at the web from far in space. To you, through your spectroscope, mapping the mazes of electromagnetism in its path, the web appears as a global efflorescence, a resonant sphere of light. It is the physical expression of the converging telecosm, the radiant chrysalis from which will spring a new global economy." [421] "The all-optical network and its increasingly broadband wireless tentacles are not two or four or ten times as good as the electronic long distance and analog cellular networks they are replacing. Collectively, they are millions of times as powerful. And Raymond Kurzweil's Law of Time and Chaos tells us these trends will only accelerate. Indeed, as we visit the new stars of the telecosmic firmament, we are finding that this is increasingly true. The rate of change is speeding up… "Even as optical opportunities break out all over the global network, Avanex sage Simon Cao, along with your Gilder Technology Report (GTR) analysts, stand almost alone in their vision of a hyper-rainbow of photons transforming the fiber sphere—where the physical layer is the fiber itself—into the lambdasphere where the physical layer consists of myriad "colors" of light. Known to physicists as lambdas, these wavelength colors can each bear more information than the entire telephone network of a few decades ago. But more important to Simon Cao and the GTR, these light waves can soon multiply into the millions and provide a cornucopia of connections. Connectivity by color rather than by numerical address can bring broadband links to the entire Internet."

Figure 1 – Unified Optical Access

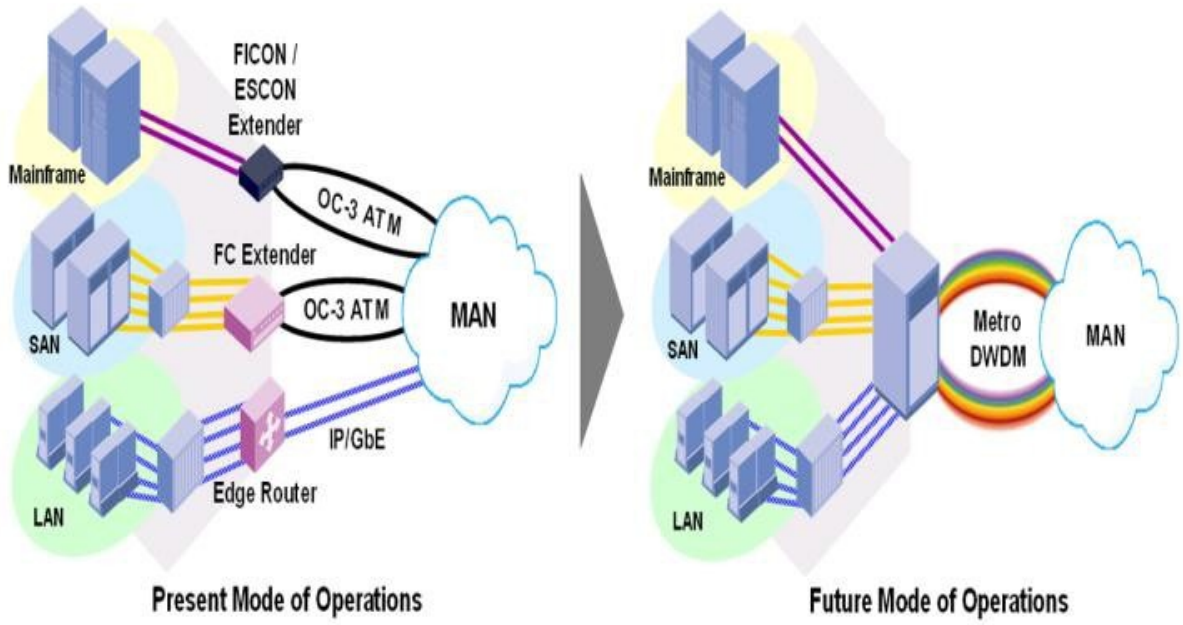


Figure 136. Credit courtesy of alcatel-lucent.com/.

Quantum computing is now being applied to a major problem that needs to be overcome at the physical layer. The binary logic of 0 and 1 is the fundamental protocol that sets the standard for all communications through that medium. First of all we must realize that the binary system is a discrete structure signifying that it is discontinuous in space-time. The on and off voltages in the logic gates design obey the rule of incoherent light sources. This is the fundamental reason why lasers although coherent, continuous and directed have to be pulsed on and off through the communication medium. I firmly believe that with the advent of spintronics **(coherent electron spin states in superconductors)** and its coherent quantum hall logic, the discrete binary logic gates at the physical layer will be eliminated. According to Wikipedia; Spintronics (a neologism meaning "spin transport electronics"[1][2]), also known as magnetoelectronics, is an emerging technology which exploits the intrinsic spin of electrons and its associated magnetic moment, in addition to its fundamental electronic charge, in solid-state devices.[422]

The original inventors of the internet at the Defense Advanced Research Project Agency (DARPA) are now recreating the physical infrastructure of the internet with this new science of spintronics. "All conventional electronics are based on the charge degree of freedom of the electron — both the numbers of charges and their energies. This program will exploit the spin degree of freedom of the electron to create revolutionary electronic devices that have the potential to be very fast at very low power. There are several aspects to this program. The first component seeks to utilize the spin degree of freedom to enhance existing devices. For example, spin transistors, spin light emitting diodes (LEDs), and spin lasers are expected to have better performance than their non-spin counterparts. The second part of this program will exploit a recently discovered coherent spin state to produce opto-electronic devices such as switches, modulators, encoders, and decoders that will operate at very high speed (again at very low power). The final component of this program will be to develop prototype quantum information processing arrays that utilize the two-level spin system for the "bits" of information ("qubits"). These quantum computers and quantum networks using qubits can perform a variety of functions far more efficiently than conventional systems based on Boolean operations (ones and zeros).[423]

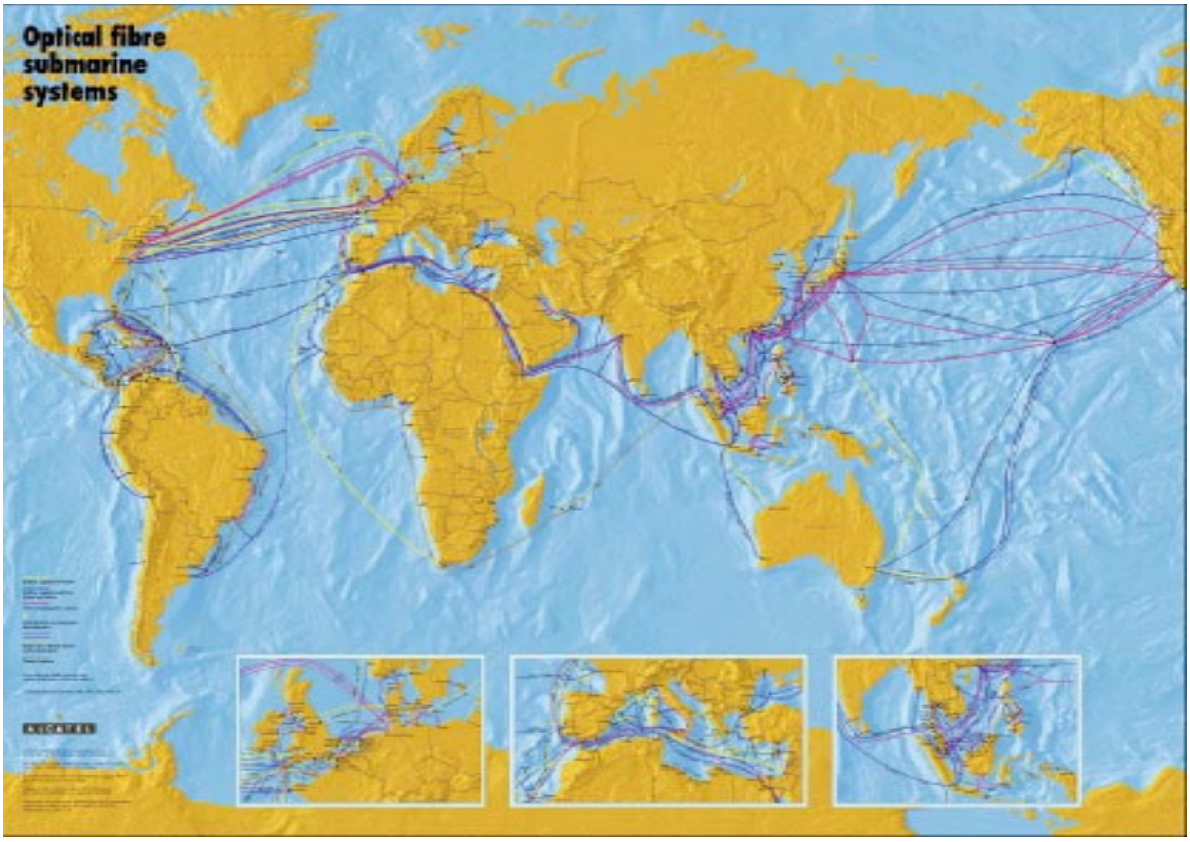


Figure 137. Truly, a "World Wide Web"… Over one billion kilometers of fiber-optic cable is now connected by a worldwide integrated, global IP-based network designed for the convergence of voice, video and data, delivering services around the planet this backbone network is constructed with the latest dense wavelength division multiplexing (DWDM) technology for expandability into the photonic powerline future. Credit: courtesy of Professor Anthony E. Siegman @ http://www.stanford.edu/~siegman/news_of_the_universe.pdf.

The Berkeley Open Infrastructure for Network Computing (BOINC) is a non-commercial middleware system for volunteer computing, originally developed to support the SETI@home project, but intended to be useful for other applications in areas as diverse as mathematics, medicine, molecular biology, climatology, and astrophysics. The intent of BOINC is to make it possible for researchers to tap into the enormous processing power of personal computers around the world. BOINC has been developed by a team based at the Space Sciences Laboratory at the University of California, Berkeley led by David Anderson, who also leads SETI@ home. As a "quasi-supercomputing" platform, BOINC has over 560,000 active computers (hosts) worldwide processing on average 1 PFLOPS as of April 7, 2008.[1] BOINC is funded by the National Science Foundation through awards SCI/0221529,[2] SCI/0438443[3] and SCI/0721124.[4] The framework is supported by various operating systems, including Microsoft Windows and various Unix-like systems including Linux, FreeBSD and Mac OS X. Released under the GNU Lesser General Public License, BOINC is free software.[424] In a growing list of distributed computing projects, that are rooted in this classical spin dynamics I found Einstein@home which connects directly to the Laser Informed mission. Einstein@Home is a distributed computing project hosted by the University of Wisconsin-Milwaukee and running on the Berkeley Open Infrastructure for Network Computing (BOINC) software platform. It searches for gravitational waves from continuous wave sources, which may include pulsars.\

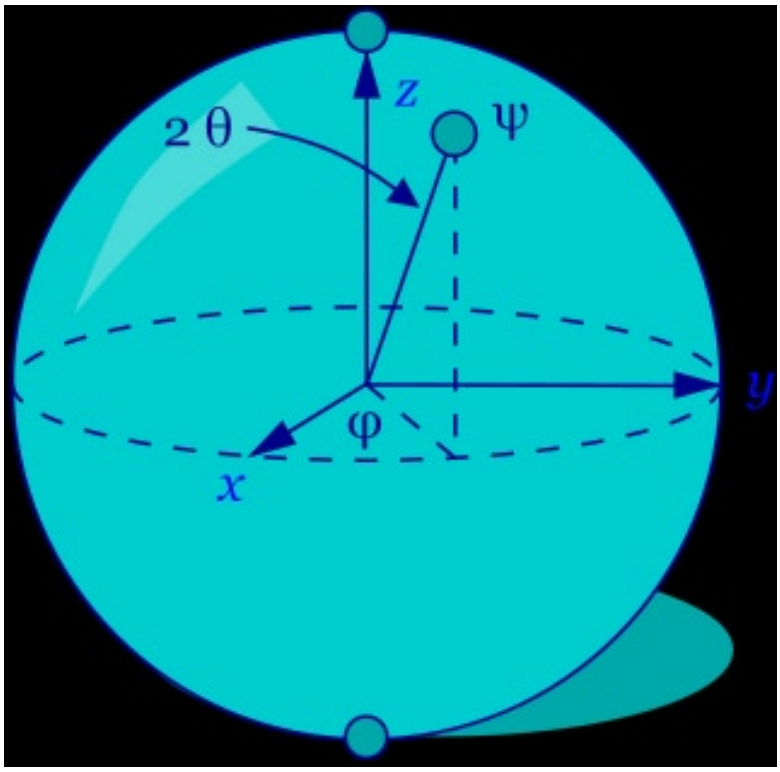


Figure 138. In quantum mechanics, the Bloch sphere is a geometrical representation of the pure state space of a two-level quantum mechanical system named after the physicist Felix Bloch. Alternately, it is the pure state space of a 1 qubit quantum register. The Bloch sphere is actually geometrically a sphere and the correspondence between elements of the Bloch sphere and pure states can be explicitly given. In generalized form, the Bloch sphere may also refer to the analogous space of an n-level quantum system.[425] Spintronics (a neologism for "spin-based electronics"), also known as magnetoelectronics, is an emerging technology which exploits the quantum spin states of electrons as well as making use of their charge state. The electron spin itself is manifested as a two state magnetic energy system. The discovery of giant magnetoresistance in 1988 by Albert Fert et al. and Peter Grünberg et al. independently is considered as the birth of spintronics. They were awarded the 2007 Nobel Prize in Physics.[426] Credit: courtesy of Wikipedia.[427]

Scientific objectives

The Einstein@Home project searches for continuous wave sources of gravitational radiation via an "all-sky search".[3] These sources may include gravitational radiation from pulsars. Einstein@Home may result in the first confirmed direct detection of a gravitational wave. A successful detection of gravitational waves would constitute a significant milestone in physics, as it would be the first detection of a previously unknown astronomical object by means of gravitational radiation alone.

Data analysis

The Einstein@Home program processes data from the LIGO and GEO instruments using Fast Fourier Transforms. The resulting signals are then analyzed using a method called matched filtering. This method involves the computation of hypothetical signals that might result if there were a physically plausible source of gravitational waves in the part of the sky being examined. The measured signal is then compared to the hypothetical signal. A matching signal is a candidate for further examination by more sophisticated analysis. [4] Einstein@Home analyzes data from the LIGO S3, S4 and S5 data sets, each of which represent improvements in the accuracy compared with the previous data set. Processing of the S3 data set was conducted between 22 February 2005 and 2 August 2005. Work on the S4 data set was started interlaced with the S3 calculations, and has finished in July 2006. Processing of the S5 data set, which should reach design sensitivity for the first time, began on 15 June 2006.[5] As of February 2008, the project reports 87.7 teraflops of computational power.[6]

Figure 139. Spinhenge@home is a distributed computing project for the BOINC client. It is a project of the Bielefeld University of Applied Sciences, Department of Electrical Engineering and Computer Science. The project began beta testing on September 1, 2006. This project uses the Metropolis Monte Carlo algorithm to calculate and simulate spin dynamics in nanoscale molecular magnets. Credit: courtesy of Wikipedia.

Optimized data analysis

Einstein@home has gained considerable attention of the world's distributed computing community when an optimized application for the S4 data set analysis was developed and released in March 2006 by project volunteer Akos Fekete, a Hungarian programmer. [7] Fekete improved the official S4 application and introduced SSE, 3DNow! and SSE3 optimizations into the code improving performance by up to 800%[Fekete was recognized for his efforts and was afterwards officially involved with the Einstein@home team in the development of the new S5 application. [8] As of late July 2006 this new official application became widely distributed among the Einstein@home users, creating a large surge in the project's total performance and productivity, best measured by floating point speed (or FLOPS), which has increased by approximately 50% compared to non-optimized S4 application. [9]428

With Spin lasers now being integrated into the physical and application layers within the 7-layer networking protocol or its equivalent TCP/IP reference model, the day is quickly approaching when the universal visual language of lasers will emerge as the only protocol necessary for all communication. Laser light will be the universal source of all information transfer ultimately converging on our Laser Informed Eyes via Microvision's VRD and the Open software platform. All these findings confirmed Gilder's prediction that the 7-Layer model will be reduced to the physical laser layer that is the Lambdasphere.

The Open Systems Interconnection Basic Reference Model (OSI Reference Model or OSI Model for short) is a layered, abstract description for communications and computer network protocol design. It was developed as part of the Open Systems Interconnection (OSI) initiative and is sometimes known as the OSI seven layer model. From top to bottom, the OSI Model consists of the Application, Presentation, Session, Transport, Network, Data Link, and Physical layers. A layer is a collection of related functions that provides services to the layer above it and receives service from the layer below it. For example, a layer that provides error-free communications across a network provides the path needed by applications above it, while it calls the next lower layer to send and receive packets that make up the contents of the path.

Even though newer IETF, IEEE, and indeed OSI protocol work subsequent to the publication of the original architectural standards that have largely superseded it, the OSI model is an excellent place to begin the study of network architecture. Not understanding that the pure seven-layer model is more historic than current, many beginners make the mistake of trying to fit every protocol they study into one of the seven basic layers. This is not always easy to do as many of the protocols in use on the Internet today were designed as part of the TCP/IP model, and may not fit cleanly into the OSI model. **OSI Model** 7 Application layer 6 Presentation layer 5 Session layer 4 Transport layer 3 Network layer 2 Data link layer LLC sublayer MAC sublayer 1 Physical layer. The physical layer defines all the electrical and physical specifications for devices. In particular, it defines the relationship between a device and a physical medium. This includes the layout of pins, voltages, cable specifications, Hubs, repeaters, network adapters, Host Bus Adapters (HBAs used in Storage Area Networks) and more. The physical layer is level one in the seven-level OSI model of computer networking as well as in the five-layer TCP/IP reference model. It performs services requested by the data link layer. The physical layer is the most basic network layer, providing only the means of transmitting raw bits rather than packets over a physical data link connecting network nodes. Neither packet headers nor trailers are consequently added to the data by the physical layer. The bit stream may be grouped into code words or symbols, and converted to a physical signal, which is transmitted over a physical transmission medium. The physical layer provides an electrical, mechanical, and procedural interface to the transmission medium. The shapes of the electrical connectors, which frequencies to broadcast on, what modulation scheme to use and similar low-level parameters are specified here. An analogy of this layer in a physical mail network would be the roads along which the vans carrying the mail drive. In the TCP/IP reference model Ethernet physical layer · Modems · PLC · SONET/SDH · G.709 · Optical fiber · Coaxial cable · Twisted pair · (more) are also part of the first layer.429

Light is kept in the "core" of the optical fiber by total internal reflection. This causes the fiber to act as a waveguide. Fibers which support many propagation paths or transverse modes are called multimode fibers (MMF). Fibers which support only a single mode are called single mode fibers (SMF). Multimode fibers generally have a large-diameter core, and are used for short-distance communication links or for applications where high power must be transmitted. Single mode fibers are used for most communication links longer than 200 meters. Joining lengths of optical fiber is more complex than joining electrical wire or cable. The ends of the fibers must be carefully cleaved, and then spliced together either mechanically or by fusing them together with an electric arc. Special connectors are used to make removable connections. Optical fiber can be used as a medium for telecommunication and networking because it is flexible and can be bundled as cables. It is especially advantageous for long-distance communications, because light propagates through the fiber with little attenuation compared to electrical cables. This allows long distances to be spanned with few repeaters. Additionally, the light signals propagating in the fiber can be modulated at rates as high as 40 Gb/s [3], and each fiber can carry many independent channels, each by a different wavelength of light (wavelength-division multiplexing). Over short distances, such as networking within a building, fiber saves space in cable ducts because a single fiber can carry much more data than a single electrical cable. Fiber is also immune to electrical interference, which prevents cross-talk between signals in different cables and pickup of environmental noise. Also, wiretapping is more difficult compared to electrical connections, and there are concentric dual core fibers that are said to be tap-proof. Because they are non-electrical, fiber cables can bridge very high electrical potential differences and can be used in environments where explosive fumes are present, without danger of ignition.

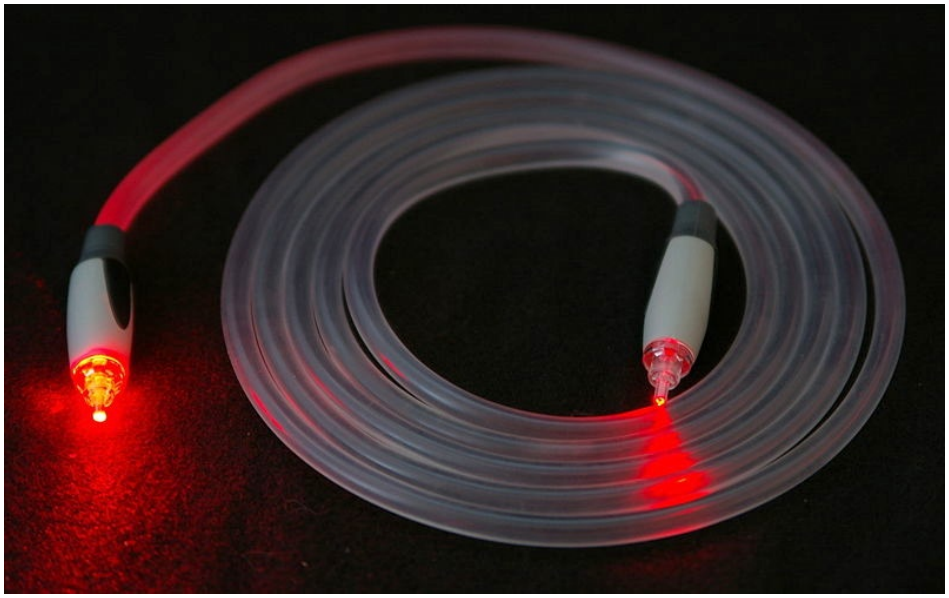


Figure 140. A TOSLINK fiber optic cable with a clear jacket that has a laser being shone onto one end of the cable. The only light is being shone into the left connector; the light coming out the right connector is from the same laser. An optical fiber is a glass or plastic fiber designed to guide light along its length. Fiber optics is the overlap of applied science and engineering concerned with the design and application of optical fibers. Optical fibers are widely used in fiber-optic communication, which permits transmission over longer distances and at higher data rates than other forms of communications. Fibers are used instead of metal wires because signals travel along them with less loss, and they are immune to electromagnetic interference. Optical fibers are also used to form sensors, and in a variety of other applications. Credit: courtesy of Wikipedia and Hustvedt.[430]

Although fibers can be made out of transparent plastic, glass, or a combination of the two, the fibers used in long-distance telecommunications applications are always glass, because of the lower optical attenuation. Both multi-mode and single-mode fibers are used in communications, with multi-mode fiber used mostly for short distances (up to 500 m), and single-mode fiber used for longer distance links. Because of the tighter tolerances required to couple light into and between single-mode fibers (core diameter about 10 micrometers), single-mode transmitters, receivers, amplifiers and other components are generally more expensive than multi-mode components. My Laser Informed intuition also led me to the discovery of the Pangolin Laser Designer software and hardware. Pangolin is one of the most powerful Laser program on both the internet and the World Wide Web because it is coherently grounded on both the application and physical Layer. The power of the Pangolin Laser Show Designer is clearly illustrated at the Rose Center for Earth and Space in New York City. Einstein's laser cosmology and scientific vision is now accessible in virtual reality and in real-time to the public thanks in part to this application of our laser intelligence. Because the Rose Center maps our position in the cosmos with a "fiber optic sky" illuminated by the "Omniscan all-dome laser" it shows the radiant destination that mankind is being prepared to access at present. This visualization of the Lambdasphere is now accessible via the World Wide Web. "The Rose Center for Earth and Space uses a fiber network of 96 multimode fibers and 48 single-mode fibers to connect the supercomputer to the Space Theater control console. The electrician/installers received special training from the cable manufacturer to assure low loss splices and connections."[431]

Figure 140An audience watches a laser light show during the SIB trade fair in Rimini, Italy in 2002Credit: Wikipedia @ http://en.wikipedia.org/wiki/Audience_scanning.

The AVI's *Omniscan*, the world's first 360 degree, full-dome planetarium laser projector. It uses custom software to control the laser, lens, and effects — and to control the Pangolin *Laser Designer* system used for all graphics and beams. This is the laser projector used at the Cosmic Cathedral (The Rose Center for Earth and Space or the New Hayden Planetarium in NYC). Omniscan is the first and only full dome, laser projection system specifically designed to create full color, dynamic astronomical effects. Used in conjunction with the Laser Designer in order to augment planetarium star projectors, Omniscan provides high-resolution vector graphic imagery to cover the entire 360 degree x 180 degree planetarium dome surface. The Laser Designer's ability to Display the Radiant light in its coherent, continuous and directed sense is to me it's most powerful function. The ultimate development and conversion of this technology to the open software platform can potentially transform the whole software industry. The visual idea of Laser intelligence in this software/hardware program brings to life the radiant notation that is the basis for the emergence of a universal visual language of lasers on the internet via its multimedia outlet, the World Wide Web.

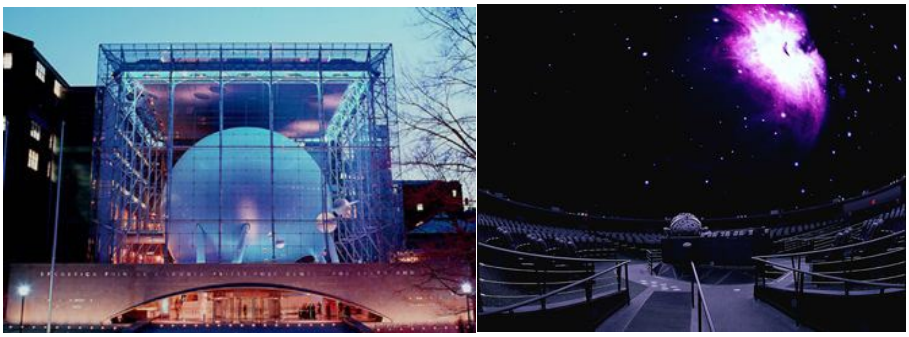


Figure 141. Credit: The Rose Center for Earth and Space.

Figure 142. Einstein at 14 years of age in 1893. Credit: courtesy of Wikipedia.

Einstein's ability to visualize enabled him to see thoughts in pictures. In part, because Einstein couldn't think well in words at first, he became a powerful visual thinker. To become a powerful visual thinker like Einstein you will need special training of your eyes and your imagination. Your imagination is directly linked to your eyes. In fact the imagination is produced by the visual cortex. I designed this book for the purpose of developing your imaginative eye. Your eyes are dependent on light so if you play with light you develop your imagination. Light is an electro-magnetic force which means that it has both electricity and magnetism. That is why the magnetic compass needle is directly connected to the light; it actually comes from the light of the sun (look at the Solar Wind above) and penetrates the Earth's core. After Einstein received the compass from his father at 5 he kept the imaginative play with it until around 12 years old his laser intelligence got another great boost when he discovered a great book on Euclidean Geometry (geo = earth, metric = measure).[432] Geometry is the original science of measuring the Earth. Through geometry (the science of space patterns that studies points, lines, curves, waves, spirals and all kinds shapes) Einstein cultivated his mathematical intelligence. The conjunction of his laser intelligence with the logical-mathematical intelligence in this geometry book enabled Einstein to discover the scientific picture of space-time and the world. This wonderful book trained and directed his imagination into mathematical physics and philosophy. Euclidean geometry comes from Euclid a Greek mathematician who lived about 2500 year ago. The Greeks mathematicians like Pythagoras and Euclid studied and learned a lot from the Egyptians pyramids. We have learned a lot from the Egyptians.

Figure 143. A representation of Euclid from The School of Athens by Raphael. Euclidean geometry is a mathematical system attributed to the Greek mathematician Euclid of Alexandria. Euclid's text Elements is the earliest known systematic discussion of geometry. It has been one of the most influential books in history, as much for its method as for its mathematical content. The method consists of assuming a small set of intuitively appealing axioms, and then proving many other propositions (theorems) from those axioms. Although many of Euclid's results had been stated by earlier Greek mathematicians, Euclid was the first to show how these propositions could be fit together into a comprehensive deductive and logical system. Credit: courtesy of Wikipedia.[433]

By 16 years of age Einstein's visual and mathematical intelligence was so well developed that he was able to imagine himself riding a bicycle on a wave of light. It was precisely with this thought experiment that light became the central theme of his career. He asked himself; what does a light-wave look like in space/time when you are traveling at the speed of light?[434] In the summer of 1895 he wrote his first scientific paper on: The investigation of the State of Aether in Magnetic Fields.[435] Einstein was deeply grounded in the visual thinking method of Johann Heinrich Pestalozzi (January 12, 1746 – February 17, 1827) who was a Swiss pedagogue and educational reformer. His educational method is to proceed from the easier to the more difficult. One begins with direct visual observation, then you pass from observation to consciousness and then from consciousness to speech descriptions. After which one comes to measuring, drawing, writing, numbers, and so reckoning. The sequence is visual, verbal, symbolic and moral. The moral (goodwill) objective of his education system was the holistic or harmonious development of the head, heart and hand.[436] Einstein had such a great adventure with light at 16 that he decided that he wanted to be a Dr. in Physics. Ten years later at 26 years of age in 1905 he finally graduated as a Dr. in theoretical Physics. For his graduation he translated into mathematical language ($E = mc^2$) what his imagination had seen when he was 16 years old. Through his scientific homework he changed our world in a very powerful way.

Figure 144. 5-meter-tall sculpture of Einstein's 1905 E = mc2 formula at the 2006 Walk of Ideas, Germany. Courtesy of Wikipedia

According to Wikipeia: In physics, mass–energy equivalence is the concept that any mass has an associated energy and vice versa. In special relativity this relationship is expressed using the mass–energy equivalence formula

$$E = mc^2$$

where

- E = energy,
- m = mass,
- c = the speed of light in a vacuum (*celeritas*).

Two definitions of mass in special relativity may be validly used with this formula. If the mass in the formula is the rest mass, the energy in the formula is called the rest energy. If the mass is the relativistic mass, then the energy is the total energy.The formula was derived by Albert Einstein, who arrived at it in 1905 in the paper "Does the inertia of a body depend upon its energy-content?", one of his Annus Mirabilis ("Wonderful Year") Papers.[1] While Einstein was not the first to propose a mass–energy relationship, and various similar formulas appeared before Einstein's theory, Einstein was the first to propose that the equivalence of mass and energy is a general principle, which is a consequence of the symmetries of space and time. In the formula, c2 is the conversion factor required to convert from units of mass to units of energy. The formula does not depend on a specific system of units. In the International System of Units, the unit for energy is the joule, for mass the kilogram, and for speed meters per second. Note that 1 joule equals 1 kg·m2/s2. In unit-specific terms, E (in joules) = m (in kilograms) multiplied by (299,792,458 m/s)2.[437] After 1905, Einstein continued to develop his visual and mathematical intelligence and eleven years later in 1916 when he was 37 years old he used his imagination again in a very special way and got the brilliant idea of the laser that everyone uses today. As you will see throughout this book, laser light is the most powerful light in the universe. How is the laser different from the other light sources, like certain aspects of the sun, moon and stars etc? The coherency or the symmetrically ordered structure of the laser's light waves (laser pointer above) in contrast to the incoherency or disordered structure of the light waves (flash light below) in all other light sources in this universe is the clearest example of the laser format. Sunlight, moonlight, starlight, bulb light, candlelight, flashlight, fluorescent lights, neon signs, light emitting diodes, are all mostly incoherent and discrete sources, their light waves are disconnected and impure mixture of colors, (figure below).

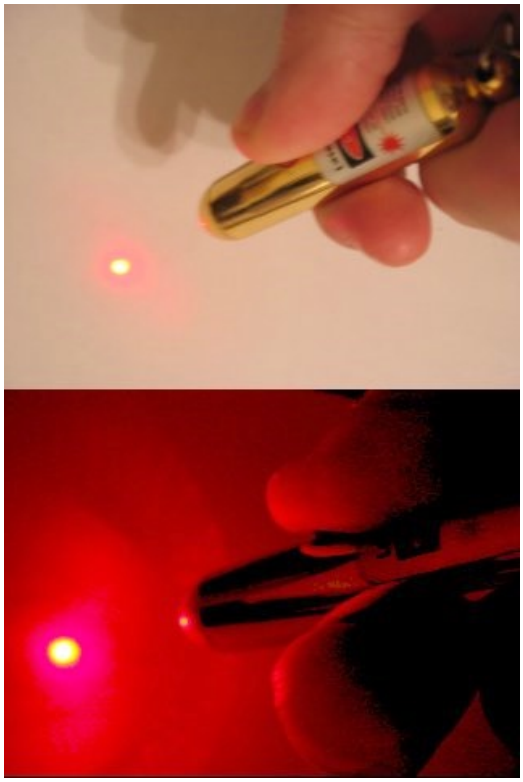


Figure 145. A laser pointer in operation, shown in light and darkness. Courtesy of Wikipedia.[438]

Figure 146. Flashlights and lanterns that utilize white LEDs are becoming increasingly popular due to their durability and longer battery life. Courtesy of Wikipedia.[439]

We are essentially living in a world that is protected by the pure coherent light of nature (the symmetry of the first law) generated by the Maser/Laser phenomenon in the Aurora Borealis and Australis of the geomagnetic sphere or Lambdasphere (The Electron Cyclotron Maser above). But this fact is also mixed in with the thermodynamic corruption of incoherent light (asymmetry), which is generated by the second law! And since light is the source of life (photosynthesis), it is through the coherent light of life that the Earth protects our being from harmful radiation and restores it to health, wealth and wisdom. And it is through the incoherent source of light that life is destroyed (entropy). It is now crucial to understand that laser light is the best source of life for our visual reason; it is the visible evidence of the reliability of our scientific thoughts. We now know there are Diamond Lasers, Sapphire Lasers, Ruby Lasers and Silicon Lasers etc. Laser Light waves in turn are coherent sources that are connected, continuous and pure. It is now imperative for mankind to consciously embrace and live this new light within itself. We will see how Einstein's precious vision of light has successfully elevated our visual perception or laser Intelligence of the world and how it is healing our planet today. We will experience the intellectual, educational, and cognitive application of this visual augmentation of the world. And we shall realize how high and profound the character of Einstein's laser intelligence truly is. The continuous, directed and coherent laser beam is narrow, pure and symmetrical, it was conceived, discovered and reproduced with the hard sciences and is now the infrastructure of the Internet pathway or Lambda information highway that leads us to the pure foundation of the world. But, since the asymmetrical, discontinuous, random and incoherent light is wide and spacious occupying 98% of all the light sources we use, destruction and confusion on the thermodynamic side of the world is almost inevitable. Because the vast majority of our scientific, technological, cultural, artistic, educational, political, financial, sociological, psychological, philosophical and theological theories are also corrupted by this light—that incoherent source of thinking and ignorance—the great majority of mankind has not realized the full implication and application of Einstein's powerful light quanta. But what does all this really mean? It means that it is the incoherent source that has distracted, diffused and misinformed our understanding of reality or disconnected our vision from the coherent light source of nature. And so when we integrate the pure light of lasers into our visual brains a pure understanding of reality emerges.

2.6: Einstein's brilliant Idea of the Laser and His Quantum Challenge

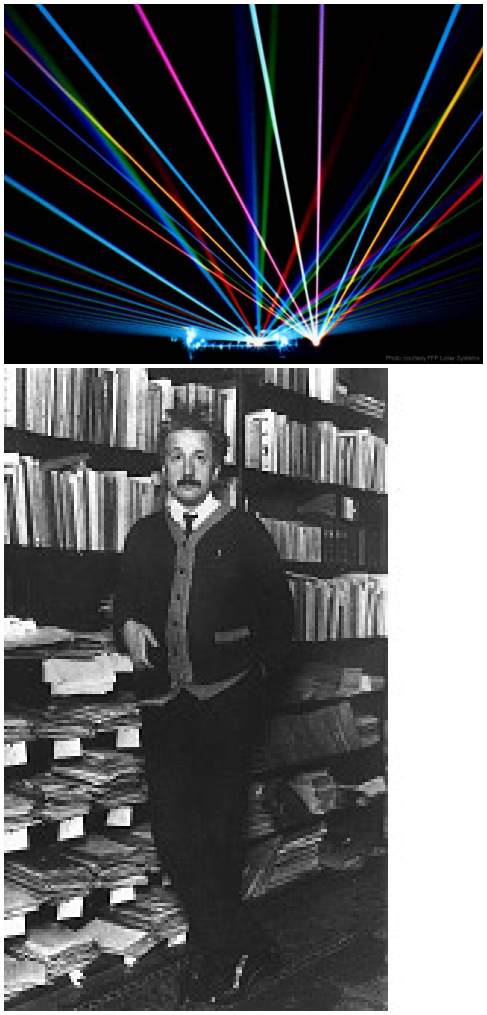


Figure 147. "For me, a hypothesis is a statement whose truth is temporarily assumed, but whose meaning must be beyond all doubt. … A theory is the more impressive the greater the simplicity of its premises, the more different kinds of things it relates, and the more extended its area of applicability." [440] Credit: courtesy of Wikipedia.

Einstein's brilliant Idea of the laser dawned on him during a period he called "the greatest satisfaction of my life," when he was 37 years old in the summer of 1916. The foundation for the laser theory came to him approximately nine months after he had completed a 10-year effort with the General Theory of Relativity, his grand oeuvre. In turn, 78 years and six months after Einstein's conception of the coherent vision of light in December of 1994; I read an article in the Scientific American magazine that ignited my interest in lasers. In this article they illustrated the huge progress in micro-lasers and their applications to the infrastructure of the internet. My thoughts were immediately oriented towards Einstein's legacy within the quantum electro-dynamic science of light. The first quotes I found immediately connected my quest for the laser to Einstein's vision of light in a very powerful way. I discovered Einstein's major contribution to laser science when he communicated his conception of the quantum light to his best friends. In a letter (1/17/1916, Doc.183) to H. A. Lorentz, Einstein expressed a wish. "If only light were shed on the absorption process!" A partial response to his wish came from a letter he received from Arnold Sommerfeld. And in appreciation of Sommerfeld's disclosure he wrote back to him on 2/8/1916 (Doc.189). "Your letter pleased me very much; your report on the spectral lines enchanted me, a revelation!" But there was one technical question that needed to be worked out. It took him about 6 months to figure it out, and so on August the 3rd, 1916 (Doc.246) he wrote back to Sommerfeld stating; "your spectral analyses number among my finest experiences in physics. It is just through them that Bohr's idea becomes entirely convincing. If only I knew which little screws the Lord is adjusting there!" The following is a technical description of Einstein's foundation paper for the theory of the laser as it is given by Wikipedia.

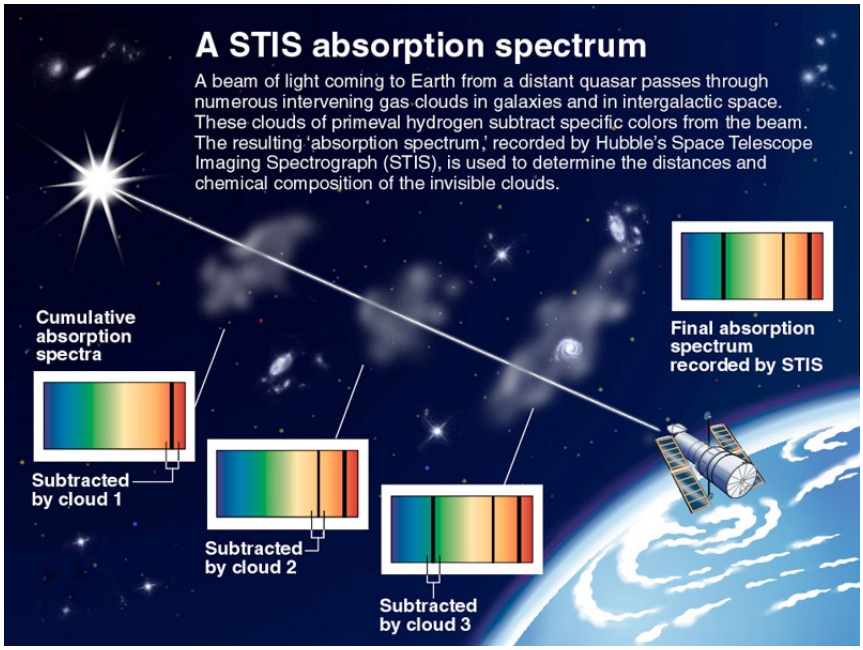


Figure 148. Figure 151. Absorption spectrum observed by the Hubble Space Telescope. A material's absorption spectrum shows the fraction of incident electromagnetic radiation absorbed by the material over a range of frequencies. An absorption spectrum is, in a sense, the opposite of an emission spectrum. Every chemical element has absorption lines at several particular wavelengths corresponding to the differences between the energy levels of its atomic orbitals. For example, an object that absorbs blue, green and yellow light will appear red when viewed under white light. Absorption spectra can therefore be used to identify elements present in a gas or liquid. This method is used in deducing the presence of elements in stars and other gaseous objects which cannot be measured directly.[441] Credit: courtesy of Wikipedia.

Atoms emit and absorb light at characteristic energies. This produces "emission lines" in the spectrum of each atom. Emission can be spontaneous, as in light-emitting diodes, gas discharge lamps (such as neon lamps and neon signs, mercury-vapor lamps, etc.), and flames (light from the hot gas itself—so, for example, sodium in a gas flame emits characteristic yellow light). Emission can also be stimulated, as in a laser or a microwave maser.[442]

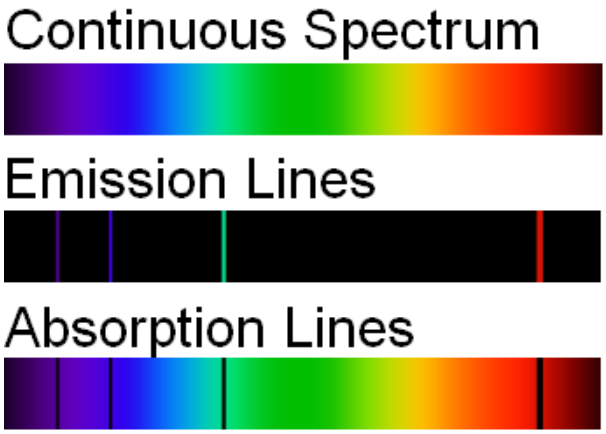


Figure 149. Emission lines and absorption lines compared to a continuous spectrum. Credit: courtesy of Wikipedia.

In physics, atomic spectral lines are of two types:

• An emission line is formed when an electron makes a transition from a particular discrete energy level of an atom, to a lower energy state, emitting a photon of a particular energy and wavelength. A spectrum of many such photons will show an emission spike at the wavelength associated with these photons.

• An absorption line is formed when an electron makes a transition from a lower to a higher discrete energy state, with a photon being absorbed in the process. These absorbed photons generally come from background continuum radiation and a spectrum will show a drop in the continuum radiation at the wavelength associated with the absorbed photons.

The two states must be bound states in which the electron is bound to the atom, so the transition is sometimes referred to as a "bound–bound" transition, as opposed to a transition in which the electron is ejected out of the atom completely ("bound–free" transition) into a continuum state, leaving an ionized atom, and generating continuum radiation.

A photon with energy equal to the energy difference between the levels is released or absorbed in the process. The frequency ν at which the spectral line occurs is related to the photon energy E by Planck's law $E = h\nu$ where h is Planck's constant.

In 1916, Albert Einstein proposed that there are essentially three processes occurring in the formation of an atomic spectral line. The three processes are referred to as spontaneous emission, induced emission and absorption and with each is associated an Einstein coefficient which is a measure of the probability of that particular process occurring. This mathematical study of The Einstein coefficients is an example from Wikipedia. http://en.wikipedia.org/wiki/Atomic_spectral_line.

Emission and absorption coefficients

The emission of atomic line radiation may be described by an emission coefficient ε with units of energy/time/volume/solid angle. ε dt dV dΩ is then the energy emitted by a volume element dV in time dt into solid angle dΩ. For atomic line radiation:

$$\epsilon = \frac{h\nu}{4\pi} n_2 A_{21}$$

where n2 is the density of emitting atoms, A21 is the Einstein coefficient for spontaneous emission, which is fixed for any two energy levels. By Kirchhoff's law, the absorption characteristics in a region of space are closely tied to its emission characteristics, so we must mention the absorption coefficient as well. The absorption coefficient κ will have units of 1/length and κ' dx gives the fraction of intensity absorbed for a light beam at frequency ν while traveling distance dx. The absorption coefficient is given by:

$$\kappa' = \frac{h\nu}{4\pi} \left(n_1 B_{12} - n_2 B_{21}\right)$$

where Iν is the spectral intensity of radiation at (and near) frequency ν, n1 is the density of absorbing atoms, and B12 and B21 are the Einstein coefficients for absorption and induced emission respectively. Like the coefficient A21, these are also constant for any two energy levels.

In the case of local thermodynamic equilibrium, the densities of the atoms, both excited and unexcited, may be calculated from the Maxwell-Boltzmann distribution, but for other cases, (e.g. lasers) the calculation is more complicated.

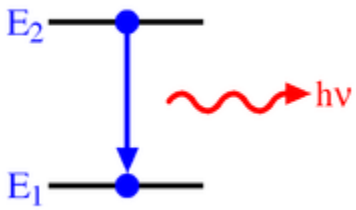
The above equations have ignored the influence of the spectral line shape. To be accurate, the above equations need to be multiplied by the (normalized) spectral line shape, in which case the units will change to include a 1/Hz term.

The Einstein coefficients

In 1916, Albert Einstein proposed that there are essentially three processes occurring in the formation of an atomic spectral line. The three processes are referred to as spontaneous emission, induced emission and absorption and with each is associated an Einstein coefficient which is a measure of the probability of that particular process occurring.

Spontaneous emission

Main article: Spontaneous emission



Schematic diagram of atomic spontaneous emission

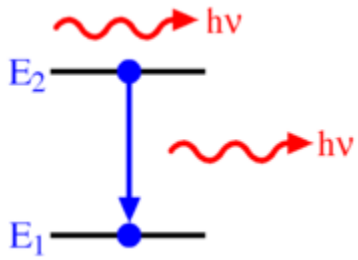
Spontaneous emission is the process by which an electron "spontaneously" (i.e. without any outside influence) decays from a higher energy level to a lower one. The process is described by the Einstein coefficient A21 (s-1) which gives the probability per unit time that an electron in state 2 with energy E2 will decay spontaneously to state 1 with energy E1, emitting a photon with an energy E2 − E1 = hν. Due to the energy-time uncertainty principle, the transition actually produces photons within a narrow range of frequencies called the spectral linewidth. If ni is the number density of atoms in state i then the change in the number density of atoms in state 1 per unit time due to spontaneous emission will be:

$$\left(\frac{dn_1}{dt}\right)_{A_{21}} = A_{21} n_2$$

Stimulated emission

Main article: Stimulated emission

Stimulated emission (also known as induced emission) is the process by which an electron is induced to jump from a higher energy level to a lower one by the presence of electromagnetic radiation at (or near) the frequency of the transition. The process is described by the Einstein coefficient B21 (sr·m2·Hz·W-1·s-1 = sr·m2·J-1·s-1), which gives the probability per unit time per unit spectral radiance of the radiation field that an electron in state 2 with energy E2 will decay to state 1 with energy E1, emitting a photon with an energy E2 − E1 = hν. The change in the number density of atoms in state 1 per unit time due to induced emission will be:



Schematic diagram of atomic stimulated emission

$$\left(\frac{dn_1}{dt}\right)_{B_{21}} = B_{21} n_2 I(\nu)$$

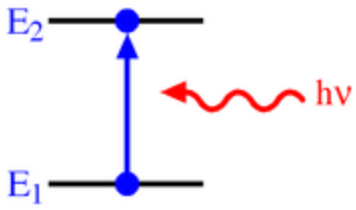
where I(ν) is the spectral radiance (in this case, radiance per unit frequency) of the radiation field at the frequency of the transition (see Planck's law).

$$I(\nu) = \frac{\frac{2h\nu^3}{c^2}}{e^{h\nu/kT} - 1}$$

Stimulated emission is one of the fundamental processes that led to the development of the laser.

Photoabsorption

Main article: Absorption (optics)



Schematic diagram of atomic absorption

Absorption is the process by which a photon is absorbed by the atom, causing an electron to jump from a lower energy level to a higher one. The process is described by the Einstein coefficient B12 (sr·m2·Hz·W-1·s-1 = sr·m2·J-1·s-1), which gives the probability per unit time per unit spectral radiance of the radiation field that an electron in state 1 with energy E1 will absorb a photon with an energy E2 − E1 = hν and jump to state 2 with energy E2. The change in the number density of atoms in state 1 per unit time due to absorption will be:

$$\left(\frac{dn_1}{dt}\right)_{B_{12}} = -B_{12}n_1I(\nu)$$

Detailed balancing

The Einstein coefficients are fixed probabilities associated with each atom, and do not depend on the state of the gas of which the atoms are a part. Therefore, any relationship that we can derive between the coefficients at, say, thermal equilibrium will be valid universally.

At equilibrium, we will have a simple balancing, in which the net change in the number of any excited atoms is zero, being balanced by loss and gain due to all processes. With respect to bound-bound transitions, we will have detailed balancing as well, which states that the net exchange between any two levels will be balanced. This is because the probabilities of transition cannot be affected by the presence or absence of other excited atoms. Detailed balance (valid only at equilibrium) requires that the change in time of the number of atoms in level 1 due to the above three processes be zero:

$$0 = A_{21}n_2 + B_{21}n_2I(\nu) - B_{12}n_1I(\nu)$$

Along with detailed balancing, we may use our knowledge of the equilibrium energy distribution of the atoms, as stated in the Maxwell-Boltzmann distribution , and the equilibrium distribution of the photons, as stated in Planck's law of black body radiation to derive universal relationships between the Einstein coefficients.

From the Maxwell-Boltzmann distribution we have for the number of excited atomic specie i:

$$\frac{n_i}{n} = \frac{g_i e^{-E_i/kT}}{Z}$$

where n is the total density of the atomic specie, excited and unexcited, k is Boltzmann's constant, T is the temperature, gi is the degeneracy of state i, and Z is the partition function. From Planck's law of black body radiation we have for the spectral radiance at frequency ν

$$I(\nu) = \frac{F(\nu)}{e^{h\nu/kT} - 1}$$

where:

$$F(\nu) = \frac{2h\nu^3}{c^2}$$

where c is the speed of light and h is Planck's constant. Note that in some treatments, the blackbody energy density is used rather

than the spectral radiance, in which case:

$$F(\nu) = \frac{8\pi h\nu^3}{c^3}$$

Substituting these expressions into the equation of detailed balancing and remembering that E2 − E1 = hν yields:

$$A_{21} g_2 e^{-h\nu/kT} + B_{21} g_2 e^{-h\nu/kT} \frac{F(\nu)}{e^{h\nu/kT} - 1} = B_{12} g_1 \frac{F(\nu)}{e^{h\nu/kT} - 1}$$

The above equation must hold at any temperature, so that the three Einstein coefficients are interrelated by:

$$\frac{A_{21}}{B_{21}} = F(\nu)$$

and

$$\frac{B_{21}}{B_{12}} = \frac{g_1}{g_2}$$

When this relation is inserted into the original equation, one can also find a relation between A21 and B12, involving Planck's law.

Oscillator strengths

The oscillator strength f12 is defined by the following relation to the cross section a12 for absorption:

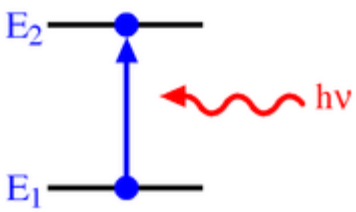
$$a_{12} = \frac{\pi e^2}{m_e c} f_{12}$$

where e is the electron charge and me is the electron mass. This allows all three Einstein coefficients to be expressed in terms of the single oscillator strength associated with the particular atomic spectral line:

$$B_{12} = \frac{4\pi^2 e^2}{m_e h\nu c} f_{12}$$

$$B_{21} = \frac{4\pi^2 e^2}{m_e h\nu c} \frac{g_1}{g_2} f_{12}$$

$$A_{21} = \frac{8\nu^2 \pi^2 e^2}{m_e c^3} \frac{g_1}{g_2} f_{12}$$



On 8/11/1916 (doc. 250) Einstein told his friend Michael Besso that with his conception of the theory of Laser Light his wish was granted in a powerful way. "A brilliant idea dawned on me about radiation absorption and emission; it will interest you. An astonishingly simple derivation, I should say the derivation of Planck's formula. A thoroughly quantized affair. I am writing the paper

right now." Here he is referring to the second paper on quantum radiation (Doc. 38), which was a continuation of the first paper. The Laser idea actually dawned on him sometime in early July or late June because he submitted the first paper, Doc. 34 of Volume 6 in the Collected Papers of Albert Einstein on July 17. "In this endeavor I feel galvanized by the following considerations, which is attractive both for its simplicity and generality."[443]The verb galvanized in this context means to apply an electric current to, or being stimulated as if by electric shock; startled; excited. This word is related to Galvanism so called after Luigi Galvani (1737 – 1798) a physiologist and physicist, it means electricity produced by chemical action, a direct electrical current used to stimulate nerves and muscles.[444] The living presence of this galvanization is to me the biological reason for Einstein's electrified hair style.

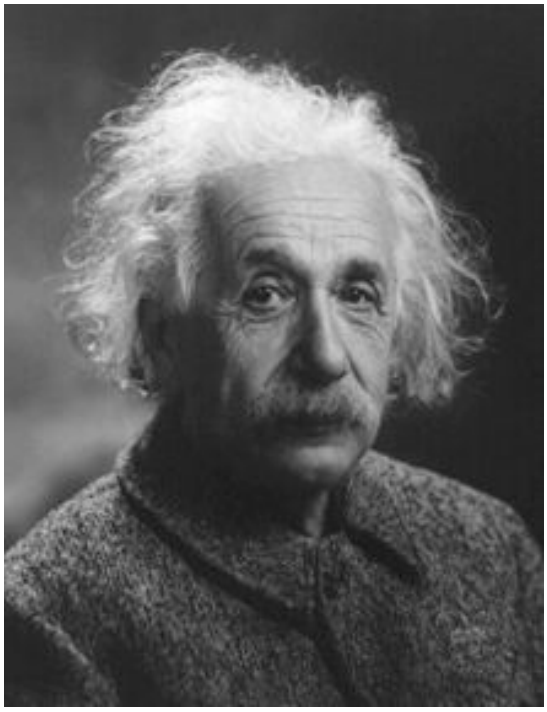


Figure 150. Albert Einstein is best known for his theory of relativity and specifically mass-energy equivalence, E = mc2. Einstein received the 1921 Nobel Prize in Physics "for his services to Theoretical Physics, and especially for his discovery of the law of the photoelectric effect."[1] [445] Credit: courtesy of Wikipedia.

According to Einstein with this new Laser informed theory "the analyses can be carried out so effortlessly, and the natural connection to Planck's linear oscillator (as a limiting case of classical electrodynamics and mechanics) seem to make it highly probable that these are the basic traits of a future theoretical representation." Judging from the 21st century this hypothesis was truly prophetic. But his insight into "the little screws the Lord" applies to the light quanta created an ambivalent sense within him. On one side "it can be demonstrated convincely that the elementary processes of emission and absorption are directed processes." (Doc.251). On the other side "the weakness of the theory is… that it does not bring us closer to a link-up with the undulating theory,… it also leaves time of occurrence and direction of the elementary processes a matter of "chance.' Nevertheless, I fully trust in the reliability of the road taking" (Doc. 38). Moreover, in doc. 306 where he discusses his "cosmic considerations" with M. Besso he stated that "the quantum paper I sent out had led me back to the view of the spatially quantum-like nature of radiation energy. But I have the feeling that the actual crux of the problem posed to us by the eternal enigma-giver is not yet understood absolutely. Shall we live to see the redeeming idea?" His final 39 years (1916-1955) search for the unification between the Space-Time continuum and Quantum physics became the ultimate quest for that redeeming idea

He died on April 18,1955, but had he lived until 1960 he would have seen and heard Theodore Maiman's empowered declaration; "LET THERE BE 'COHERENT' LIGHT," (Laser Odysee, 2000) when he invented the first ruby laser. According to Albrecht Folsing in his book Albert Einstein—that period from November 1915 to February 1917 along with the miraculous year of 1905 was undoubtedly the most fruitful period in Einstein's work. During these fifteen months he produced fifteen scientific treatises (volume 6 of his collected papers), including the two significant contributions to quantum theory and, above all, the brilliant culmination of the general theory of relativity and the foundations of a scientific cosmology in the light of newly discovered possibilities. He produced these achievements in what for him was a difficult time, amid family crises and the noise of war. (Page 393).

For me it was more precisely in a chapter entitled; Enter Einstein on page 21 of a little book I borrowed from the Lancaster PA public library called: LASERS, LIGHT WAVE OF THE FUTURE by Allan Maurer, that I suddenly realized that 98% of all the light sources that we use in this world is actually incoherent, random, diffused and disordered (flash light illustrated above) only the LASER beam is coherent, directed, powerfully focused and ordered (Laser pointer illustrated in figure 145). Once I understood that sunlight, moonlight, candlelight and most other kinds of light sources except the laser (figure 146) were incoherent (disconnected and out of phase, upper figure) I knew that now humanity was well positioned to understand the true power of its visual reasoning faculty. Through this investigation of Einstein's conception of the quantum light I realized that mankind has a superior visual power of reasoning within it and that by lifting our Laser Informed Eyes to the coherent light of reason, we open ourselves to the fulfillment of our full potential.

According to Siegman "the term coherence necessarily refers not to one property of a signal at a single point in space and time, but to a relationship, or a family of relationships, between one signal at one point in space and time, and the same or another signal at other points in space and time… Coherent amplification means in this context that the output signal after being amplified will more or less exactly reproduce the input signal, except for a substantial increase in amplitude." [446] With this quote, I started to understand how Einstein's intelligent vision can now be reproduced with the coherent fidelity of lasers. I discovered that with the power of Lasers we can effectively reproduce Einstein's concentrated mindset and amplify it. Because through his laser formula he empowered us to cultivate and take care of that light, to make it fruitful and to multiply our powers of thinking and being so that we can be wise directors of the universe in accordance to his direction. But it was due to Neils Bohr's embrace of uncertainty as the foundational interpretation of physics that the quantum community failed to follow Einstein's original signal, insight or will and so the quantum community in a large part failed to understand his non statistical position and so disconnected from the coherence of his global insight. Dr Laughlin clarified Einstein's dilemma for me even further when he stated that: "The existence of universal quantities that can be measured with certainty is the anchor of physical science… The idea of certainty emerging through organization is deeply embedded in the culture of modern biology, and is one of the reasons my colleagues in the life sciences are so eager to declare their tolerance of uncertainty. It shows they know the scoop. What they actually mean by such statements is that microscopic uncertainty does not matter, because organization will create certainty later on at a higher level… Were it really the case that the essence of biology is uncertainty, then biology would not be science… Technical knowledge is just as susceptible to political whim as any other kind of knowledge, and it is only the anchor of certainty that gives science its special status and authority. The striving for certainty is not an anachronism of a bygone era promoted by Luddite physicists but the moral core of science."[447]

In Einstein's direction Munir Frederick Bhatti's review of Carver Mead's master piece: Collective Electrodynamics: Quantum Foundations of Electromagnetism @ Amazon.com is the best introductory summary of this book I have ever seen.[448] "Despite his preface upbraiding physicists for their work of the past 50-75 years, the main text makes reasonable claims based upon well-founded experimental and theoretical results. The book endorses earlier work of Einstein, Feynman, Riemann, Lorentz, Maxwell, Planck, and others while making computational and conceptual adjustments to accommodate modern experimental results.

Figure 151. Carver Mead Gordon and Betty Moore Professor of Engineering and Applied Science, Emeritus B.S., Caltech, 1956; M.S., 1957; Ph.D., 1960; D.Sc.h.c., University of Lund (Sweden); D.Hon., University of Southern California. Credit: courtesy of Caltech.

Also in the text, Bohr and other die-hard quantum statisticians are continually under attack for their pooh-poohing of possible phenomena, algorithms, and concepts behind the observed quantum behavior. Bohr and his clan, apparently, claimed that the statistics made up the whole baseball team of quantum physics--and that we should not, and could not, look further.

In refuting this micro-labotomic approach of Bohr; Dr. Mead makes reference to systems--macroscopic in size--that exhibit quantum behaviors. While he mentions lasers, masers, semiconductors, superconductors, and other systems in the text, the primary results of the book hinge upon experimental results from the field of superconductors. He points out that physics can be split into several areas:

Classical Mechanics explains un-coherent, uncharged systems such as cannon balls, planets, vehicles, etc. Classical Electrodynamics explains un-coherent, charged systems such as conductors, currents, and their fields. Thermodynamics explains

how macroscopic statistics, such as temperature and entropy, guide the time evolution of systems. Modern Quantum Mechanics tries to explain coherent, charged systems.

Here 'coherent' refers to quantum coherency, where many particles/atoms march to the same drum such as the photons in a laser, or the electrons in a superconductor, or any isolated one or two particles. Another description of coherency is that the states are quantum entangled; their time-evolution depends upon each other.

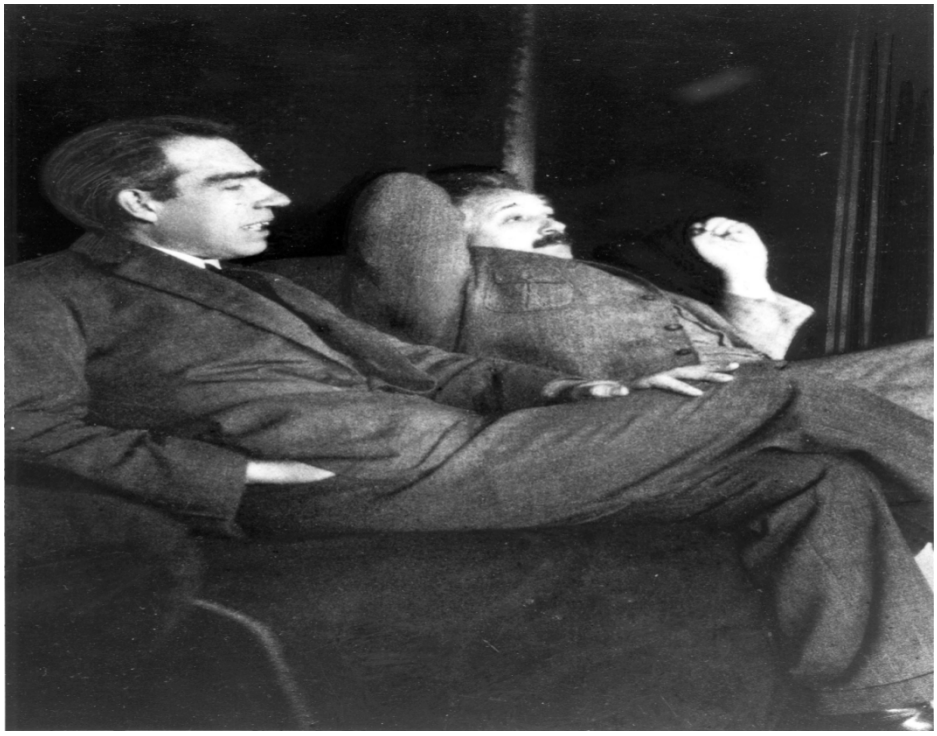


Figure 152 Niels Bohr with Albert Einstein at Paul Ehrenfest's home in Leiden (December 1925). Photo courtesy of Wikipedia. The Bohr-Einstein debates is a popular name given to what was actually a series of epistemological challenges presented by Albert Einstein against what has come to be called the standard or Copenhagen interpretation of quantum mechanics. Since Einstein's closest friend and primary interlocutor in the "school" of Copenhagen was the physicist Niels Bohr, and since it was Bohr who provided answers to most of the challenges presented by Einstein, what was actually a friendly and fruitful series of exchanges of ideas has taken on the label of a "debate". http://en.wikipedia.org/wiki/Bohr-Einstein_debates.

The thrust of Carver's book: QM applies to all matter--not just small systems or isolated particles--is well made. He brings up experimental data from superconductors to illustrate that the phenomenon of coherent quantum entanglement can, and does, occur at macroscopic scales; and that such behavior is very quantum. Thus he proves, quite convincingly, that quantum mechanics applies to all coherent systems.

He then closes by making some very important points.

1. He shows that quantum behavior of such systems can be expressed in quantum language (wave function), relativistic language (four-vectors), or electrodynamics (vector potential, scalar potential) in an equivalent fashion. This is important, as it proves that a superconductor is macroscopic, exhibits quantum behavior, and that these quantitative results agree with those found from the other approaches.

2. He makes the point that the quantum and relativistic equations show that electromagnetic phenomena consist of two parts: one traveling forward in time; the other backward in time. Feynman and others have said this for a long time, and he shows how thermodynamics (or un-coherent behavior) forces what we see as only time-evolution in one direction in un-coherent systems.

3. He illustrates, modeling single atoms as tiny superconducting resonators, that two atoms that are coherently linked will start exchanging energy. This causes an exponential, positive-feedback loop that ends with each atom in a quantum eigenstate. Thus quantum collapse is neither discontinuous, nor instantaneous; and in fact makes a lot of sense.

4. He explains, using four-vectors, that all points on a light-cone are near each other in four space. This point--together with (2)--shows that there's no causality contradiction between relativity and quantum mechanics. For example, he explains that two entangled particles, such as photons light years apart, can affect each other immediately if one falls into an eigenstate,

since the four-dimensional distance between them (R1 dot R2) is zero. Although separated in three space, they're neighbors in four space. Through these demonstrations and proofs, he successfully suggests that there is a way to further develop the 'behavior of charged, coherent systems' such that quantum mechanics and relativity will agree--but the conceptual changes he suggests are necessary and must be further developed. Also, he admits that a better, more appropriate mathematical and computational methods will be needed, since the complexity of coherent systems runs as n^2.

Pleasantly, then, the book makes elegant, defensible, mathematical and conceptual steps to resolve some nagging points of understanding. Also, the narrative gives the best introduction to electrodynamics and quantum mechanics that I've ever seen. Since the theoretical criticisms and experimental data are quite valid, his proposed resolutions are eye-opening and valuable. The methods he suggests greatly simplify thinking about complicated quantum/classical problems. New approaches for future theoretical research are also suggested. Despite the dark tone in the preface, the book is positive, enlightening, and well anchored to accepted, modern experimental results and theoretical work.

It's a short book, about 125 pages, and well worth the read. Familiarity with classical and quantum physics, and special relativity, is required to get the most out of it. As you can tell, I enjoyed it tremendously."

In Einstein's biography, Albrecht Folsing refers to Einstein 1916 paper on the quantum radiation of the Laser in a parallel fashion; "Einstein proceeded from Niels Bohr basic—and by then well tested—assumption that the electron within an atom occupy a number of discrete energy states, and are able, through emission or absorption of radiation, to pass from one of those states to another. Added to this was an assumption of thermodynamic equilibrium between radiation field and atom, as well as consideration of the "classical" limiting case at high temperatures—and there was Planck's formula. This brief argument, a mere two pages, also covers emission stimulated by the radiation field; thus the formulas already, by implication, contain the theory of the laser, though it was to take nearly half a century to be realized."[449]

Fundamentally it was those "well tested assumptions" about the discrete energy states that Einstein debated vehemently against Bohr in 1927 and 1930. He also fought strongly until his deathbed, against the statistical model as the foundation of quantum reality. Mead stated that "Einstein and Schrödinger both made central contributions to the emerging quantum discipline, but never bought into the orthodoxy of Bohr's Copenhagen clan. There was no disagreement about the numbers the equations gave for the hydrogen energy levels; the dissent was over the conceptual interpretation of the theory. Bohr insisted that the laws of physics, at the most fundamental level, are statistical in nature… By contrast Einstein famously argued that "the Lord does not throw dice." He believed that electrons were real and he wrote, in 1949, that he was "firmly convinced that the essentially statistical character of contemporary quantum theory is solely to be ascribed to the fact that this [theory] operates with an incomplete description of physical systems… I agree, the inner theoretical foundation is non-statistical, even though the external mathematical description started out statistically.

It was Carver A. Mead in his great work, cited above--who gave me the clearest explanation of Einstein's historical and foundational perspective on light. I believe it is exactly as he pointed out, that "to make contact with the fundamental nature of matter, we must work in a coherent context in which the underlying quantum reality has not been corrupted by an incoherent averaging process. Traditional treatments of quantum mechanics universally confuse results that follow from the wave nature of matter with those that follow the statistical nature of the experiment. In the usual picture, these aspects are inextricably intertwined. Einstein himself had a massive case of this confusion and it cost him the debate with Bohr." [450]

The source of this confusion is so powerful that Ludwig Boltzmann (1844—1906), the founder of statistical mechanics, took his own life in 1906, partly because he saw no way out of a conflict that he thought had paralyzed his thinking. Most commentators restrict Boltzmann mental problem to his social relations, but I believe the problem was also psychological incoherence.[451] The statistical theory is also the fundamental obscurity that prevented Einstein and his successors from realizing the unified field theory. The incoherence between the statistical logic of quantum theory derived from the second law of thermodynamics (asymmetry) and the classical deductive logic of relativity theory derived from the first law (conservation and symmetry)is the root cause of the problem. For Einstein "the unified field theory has been put into retirement. It is so difficult to employ mathematically that I have not been able to verify it somehow, in spite of all my efforts. This state of affairs, will no doubt last many years, mostly because physicists have little understanding of logical-philosophical arguments."

According to Webster's collegiate dictionary incoherence means lack of coherence, not sticking together, not logically connected, disjointed, and rambling in speech and thoughts. In the vegetable kingdom, the photosynthesis of incoherent light produces short-lived corruptible products. Photosynthesis, the harvesting of incoherent light energy from the sun and the storage of energy in chemical form for use by an organism to drive its physical processes is the principal basis for our short life on Earth. Bio-photonic coherency will extend our life indefinitely.

> **Photobiomodulation**, also known as **low level laser therapy** (**LLLT**), **cold laser therapy**, and **laser biostimulation**, is an emerging medical and veterinary technique in which exposure to low-level laser light or light emitting diodes can stimulate or inhibit cellular function leading to beneficial clinical effects.[1] The technique is also known by the more ambiguous terms *phototherapy* and *laser therapy*, which may also be used to describe other medical techniques. The "best" combination of wavelength, intensity, duration and treatment interval is complex and sometimes controversial with different diseases, injuries and dysfunctions needing different treatment parameters and techniques. These are still being explored and increasingly published by the academic community. [452]

In animal biology, incoherence produces the death of a body due to the separation or disintegration of cell and system. And in

the brain it produces decoherence, the incoherent quantum aggregates that destroy the coherent quantum state emitted by DNA, the sensory system and the transduced light in the retina.

In Geology, incoherence is in a rock or deposit that is loose or unconsolidated, or that it is unable to hold together firmly or solidly. Here we see precisely why the Diamond, the Ruby and the precious stones are some of the most valuable substances on Earth, their solid integration is the antidote containing the secret that lead us to the harmony or coherency of nature. Incoherent light is electromagnetic radiant energy that is out of phases or out of harmony with other waves and which is constituted by a chaotic multiplicity of wavelengths.

Just as Laser Vision Correction surgically cures the physiological maladies of the eyes, Laser Cognition Correction with the Virtual Retinal Display will cure our intellectual problems with decoherence (macroscopic destruction of quantum coherence), due to the brains exposure to the incoherent side of the world. We can harness the coherency of the electron cyclotron maser in the magnetosphere via optical programming. And we can establish harmony on planet Earth and perhaps the entire universe via LaserFusion power and its distribution via the emerging photonic power lines.

Einstein's first 1905 paper entitled "**a heuristic viewpoint concerning the generation and transformation of light**," led him to the formulation of the photoelectric effect that won for him the 1921 Nobel prize and made him one of the founding fathers of quantum physics. In this paper he introduces the notion of "photons" the quantum light particle associated with the granular or discrete appearance of light. This is the first scientific identification of the incoherent source of light in this universe. In the spring workshop of 1905 he gave Conrod Habicht a foretaste of this identification. "[I will send you] four papers. [The first] deals with radiation and the energetic properties of light and is very revolutionary... the second paper determines the true size of atoms by way of diffusion and the viscosity of diluted solutions of neutral substances. The third proves that, assuming the molecular theory of heat, bodies on the order of magnitude of 1/1000 mm, when suspended in liquids, must already have an observable random motion that is produced by thermal motion.... The fourth paper is only a rough draft now, and is about the electrodynamics of moving bodies that employs a modified theory of space and time. [453]

Mead again helped me identity the incoherent light source in Einstein's quantum paper. Mead also helped me see how we can liberate ourselves from the incoherent light through "**the character of reversibility**" identified in Einstein's papers as the inwardly propagated coherent light waves. This light is now seen as the future to past temporal direction.[454] "Ironically, the quantum nature of radiation was an invention of Einstein. In his 1905 paper (p.86 in Ref. 55), he introduces this possibility:

"According to the assumption to be contemplated here, when a light ray is spreading from a point, the energy is not distributed continuously over ever-increasing spaces, but consists of a finite number of energy quanta that are localized in points in space, move without dividing, and can be absorbed or emitted only as a whole."

His view point reflected the then-universal belief, that the radiation itself contains the degree of freedom in which the energy resides… Referring to his earlier (1905) paper, he comments:

"By a route described in that study, I was led to the view that light… can only be absorbed or emitted in quanta of energy."

This statement contains no reference to where the energy is located. In 1909, Einstein gave an overview talk (p. 379 in Ref. 55) that clarified his views even further:

"According to the prevailing theory, an oscillating ion produces outwardly propagated spherical waves. The opposite process does not exist as an elementary process. It is true that the inwardly propagated spherical waves are mathematically possible; however, its approximate realization requires an enormous amount of emitting elementary structures. Thus, the elementary process of light radiation as such does not possess the character of reversibility. Here, I believe, our wave theory is of the mark."

In other words, the elementary radiation process seems to proceed such that it does not, as the wave theory requires, distribute and scatter the energy of the primary electron in a spherical wave propagating in all directions. Rather, it seems that at least a large part of this energy is available at some location… **the elementary process of radiation seems to be directed**.

From these statements, and from his 1905 paper, it might seem that Einstein would continue to pursue the idea of light quanta as little bullets carrying energy. Instead, he reached a tentative conclusion very much in keeping with the views put forward in this monograph:

Would it not be possible to replace the hypothesis of light quanta by another assumption that would also fit the known phenomenon? If it is necessary to modify the elements of the theory, would it not be possible to retain at least the equations for the propagations of radiation and conceive only the elementary processes of emission and absorption differently than they have been until now?

By 1909, Einstein had already moved past the naïve "bullet" view of quanta that overtook physics in the late 1920s. Can there be any wonder that he was so frustrated with the Copenhagen clan?[455]

Dr. Milo Wolff substantiates the above analysis with the following conclusion. "Prof. Carver Mead at Cal Tech investigated the e-m consequences of the WSM (wave structure of matter) in 'Collective Electrodynamics' [8]. This book, very popular in Silicon Valley, shows correct ways to solve the electromagnetic of transistor circuits using the wave structure of the electron and a vector

potential in place of the erroneous (predicted by Einstein- above) Maxwell Equations. He recognized that the electron is not a point particle but a wave structure…

Abstract: The structure of the electron is investigated and found closely entwined with the origin of the natural laws. The natural laws had been measured for hundreds of years but no one knew how Nature creates them. Richard Feynman wrote, speaking of the Conservation of Energy, Nature has a hidden accountant who keeps honest books of energy input and output but we don't know how she does it. The origins had been proposed earlier by Clifford and Schrodinger, who pointed out that only a Wave Structure of Matter (WSM), can explain natural laws. Further, Einstein realized that matter was spherical and spatially extended and thus the Electron was not a point particle, but rather, a structure of space. He writes; Physical objects are not in space, but these objects are spatially extended. In this way the concept empty space loses its meaning. ... Since the theory of general relativity implies the representation of physical reality by a continuous field, the concept of particles or material points cannot play a fundamental part, nor can the concept of motion. The particle can only appear as a limited region in space in which the field strength or the energy density is particularly high. (Albert Einstein)

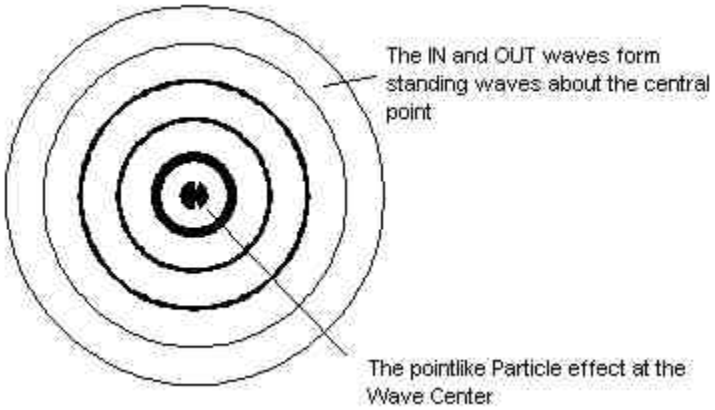


Figure 153. Einstein's error was to represent matter as a continuous spherical field in space-time rather than as a Spherical Wave in continuous Space which causes the spherical force field effects.

Using the WSM a quantitative origin has been found based on the wave structure of the electron. It is shown that Space (the quantum wave medium) is a single entity underlying electron structure and the laws. Three Principles are found describing the wave medium, enabling calculation of particles and the laws. The predictive power of the WSM is shown by deriving the previously unknown physical origin of electron spin and making experimental predictions which solve the paradoxes of the famous EPR experiment. The WSM has important implications for research, industry, and our human role in the universe.

F. Conclusions: The proposals of Clifford and Schrödinger are correct that an electron is a continuous wave structure of equal inward and outward waves, not a material particle, whereas point particles and electromagnetic waves are merely appearances (schaumkommen). Figure above shows the Huygens's in-wave fronts traveling towards their wave-centers, a continual process analogous to the response of the universe. There is no causality violation because the in-waves are real and do not run backwards in time." (This last assertion by Dr. Wolf is interpreted as time symmetry, both by Dr. Mead and the current laser experiments with the time reversed light, see Dr. Nolte's article).[456]Dr Wolf continues to inform us that "the wave medium is the space around us that, although we do not interact directly with it, governs our observations of inertia such as the laser gyro. It has an energy density exceeding 10^40 Mev/cc. The Schrödinger wave functions are not probabilities. They must be interpreted as the matter itself. Many classic paradoxes, including, 'renormalization', wave-particle duality, and Copenhagen uncertainty, no longer occur. They were caused by the notion of a material particle that does not exist."[457]

So now we can understand why Einstein's groundbreaking identification of the incoherent light source of nature in 1905 gave him an incomplete visual sense of the reality of light, so he kept focusing his vision until in 1916 his perception penetrated into the coherent side of the light. But even while he was already on the coherent side of the light he still felt that his visual perception was incomplete due to the statistical formulation of the theory that impeded the complete vision of reality. This awareness led him for the last 39 years of his life, to the unceasing search for a unified field theory, or better yet to a coherent vision of reality. Three centuries after Newton, says Dipankar Home, 'we have to admit that we still cannot answer the question" what is light?"' and he gleefully points to a remark made by Einstein in 1951, in a letter to his old friend Michelangelo Besso: 'All these fifty years of conscious brooding have brought me no nearer to the answer of the question" what are light quanta?" Nowadays every Tom, Dick and Harry thinks he knows it, but he is mistaken…'[458] I admire to the highest degree the achievements of the younger generation of physicists, which goes by the term quantum mechanics, and believe in the deep level of truth of that theory; but I believe that its limitation to statistical laws will be a temporary one."[459] "Had he stuck to his hunch that the fundamental laws are continuous, he would have fared better; but to do that, he would have needed a model quantum system in which statistics plays a vanishingly small role. At the time, no such system was known. Today, we have many such systems.[460]

Mead continuous with the energetic statement that "Einstein was firmly of the belief that statistics have no place in the

fundamental laws of physics, while Bohr believed that only statistical information is meaningful in quantum theory. Unfortunately, much of the debate centered around the uncertainty relation, which, from our present point of view, is not about statistics at all, but results from the wave nature of matter. At that time, there were no compelling experiments where the wave nature of matter was manifest in a non-statistical manner. During the entire period, there was spirited debate in and around the apparently discontinuous nature of quantum transitions, a retrospective of which is Schrodinger's paper, 'are there quantum jumps?[461] Under the pressure of Bohr's constant verbal abuse, Schrödinger finally gave up his quest for a theory that would be continuous in both space and time. It was much later that this quest was put on a firm foundation, notably by Barut, Zeh, and their collaborators.[462]

Einstein stated that "to be sure, it has been pointed out that the introduction of a space-time continuum may be considered as contrary to nature in view of the molecular structure of everything which happens on a small scale. It is maintained that perhaps the success of the Heisenberg method points to a purely algebraic method of description of nature, that is to the elimination of continuous functions from physics. Then, however, we must also give up, by principle, the space-time continuum.[463] Einstein and Schrödinger believed in a continuous space-time, that the statistical nature of the experimental results was a result of our lack of knowledge of the state of the system, and that the underlying physical laws can be formulated in a continuous manner. Schrodinger put it this way: "I no longer regard this [statistical] interpretation as a finally satisfactory one, even if it proves useful in practice. To me it seems to mean a renunciation, much too fundamental in principle, of all attempts to understand the individual process." In the Schrödinger centenary volume (ref. 23), Jon Dorling makes a convincing case for reviving the continuous space-time view of Einstein and Schrödinger, arguing that physics would be in less trouble with their approach than it is now."[464] For a comprehensive look at all the approaches to the interpretation of quantum mechanics go to Wikipedia.

"An interpretation of quantum mechanics is a statement which attempts to explain how quantum mechanics informs our understanding of nature. Although quantum mechanics has been tested extensively in very fine experiments, some believe the fundamentals of the theory are yet to be fully understood. There exist a number of contending schools of thought, differing over whether quantum mechanics can be understood to be deterministic, which elements of quantum mechanics can be considered "real," and other matters. Although today this question is of special interest to philosophers of physics, many physicists continue to show a strong interest in the subject." [465] In the 21st century great advances in the Einsteinian deterministic direction of quantum interpretation are being made. See the New Scientist front page for March 22-28, 2008: The (Un) Certainty Principle. Quantum reality isn't random. It just looks that way, by Mark Buchanan.[466] A leader in this Einsteinian approach is Dr. Sheldon Goldstein at Rutgers Mathematics Department, New Brunswick, NJ. You can get a glimpse of his work in a very interesting paper entitle: Bohmian Mechanics and Quantum Information_ July 25, 2007. Abstract: Many recent results suggest that quantum theory is about information, and that quantum theory is best understood as arising from principles concerning information and information processing. At the same time, by far the simplest version of quantum mechanics, Bohmian mechanics, is concerned, not with information but with the behavior of an objective microscopic reality given by particles and their positions. What I would like to do here is to examine whether, and to what extent, the importance of information, observation, and the like in quantum theory can be understood from a Bohmian perspective. I would like to explore the hypothesis that the idea that information plays a special role in physics naturally emerges in a Bohmian universe.[467]

In his classic book, 'LASERS' of 1985, Anthony Siegman,[468] confirms Einstein, Schrodinger and Mead's new approach to that vision of the coherent, directed and continuous laser light. Siegman identifies the discrete photon picture of the quantum phenomenon as a misnomer, because it misses the complete view. "In a fully correct quantum description, most atoms are not likely to be exactly "in" one quantum level or another at any given instant of time. Rather, the instantaneous quantum state of any one individual atom is usually a time-varying mixture of quantum states, for example, the upper and lower states of a laser transition. The populations N1 and N2 represent averages over all the atoms of the fractional amount that each atom is in the lower or the upper quantum state in its individual state mixture. Applying an external signal therefore does not cause an individual atom to make a sudden discrete "jump" from one level to the other. Rather, it really causes the quantum state mixture of each atom to begin to evolve in a continuous fashion. Quantum theory says that an atom initially more in the lower level tends to evolve under the influence of an applied signal toward the upper level, and vice versa. This changes the state mixture or level occupancy for each atom, and hence the averaged values N1 and N2 over all the atoms. Individual atoms do not make sudden jumps; rather, the quantum states of all the atoms change somewhat, but each by a very small amount. We should emphasize, finally, that laser materials nearly always contain a very large number of atoms per unit volume. Densities of atoms in laser materials typically range from ~ 1012 to ~ 1019 atoms/cm3. This density is sufficiently high that laser amplification is an essentially smooth and continuous process, with very little "graininess" or "shot noise" associated with the discrete nature of the atoms involve."

Figure 154. Propagation of ultrashort laser pulses in a microstructured optical fiber. The input laser light (bottom of the picture, not visible before entry into the fiber) is near infrared and generates wavelengths covering most of the visible spectrum. In optics, supercontinuum[469] is very broadband light that is generated by nonlinear processes.[470] A proportional thought structure clarified for me the Law of Accelerating Returns in the microscopic time dimension of supercontinuum lasers;" A femtosecond is to a second what a second is to 34 million years."[471] Please watch a video on holy fibers and supercontinuum from the University of Auckland @ http://laserweb.org/node/804.[472] Credit: courtesy of Wikipedia.

Mead continuous to vindicate Einstein's position, "we can thus answer Schrödinger's rhetorical question, "Are there quantum jumps?" Indeed, there are quantum jumps, but they are not discontinuities. They may look discontinuous because of the non-linear, self-reinforcing nature of a quantum transition; but at the fundamental level, everything can be followed in a smooth and continuous way, and we can view nature as being continuous in both space and time. This picture of nature is what Einstein wanted most. But to arrive at this picture, we had to give up the one-way direction of time. And allow coupling to everything on the light cone (figure 155). This, too, was okay with Einstein. So why was he so hung up on local causality? Why do all the textbooks state that the coupling of states unified by a light cone is a violation of relativity? In science, as in all aspects of human endeavor, each age has its blind spots, and what is impossible to comprehend in one generation seems natural and obvious to another. So, after only one generation, Zeh could say, "There are no quantum jumps, nor are there particles," The coherent world has continuous wave functions, and abrupt-but-continuous quantum transitions.[473]

According to Mead, physics is divided into two disciplines; on one side we have the study of incoherent systems composed by classical mechanics, electricity, and magnetism and on the other we have the study of coherent systems with relativity and quantum theory. Bohr's correspondence Principle was supposed to connect both domains, but in Meads view what Bohr introduced was a terrible confusion into modern Physics, characterizing the last 70 years since its introduction as "the dark ages of theoretical physics." Therefore, by not following Einstein's directed wisdom of the universe, the theoretical quantum community was led astray. Moreover, according to John Cramer "the visualization of quantum phenomena has been denied us for half a century, not by the abstract Quantum Mechanical formalism but by the Copenhagen interpretation. The transactional interpretation of the same formalism now makes this long-sought visualization possible. "So, how do we get a foothold to start our new approach? It helps to identify some of the confusions that exist in the standard quantum picture (proposed by the Copenhagen School led by Niels Bohr). The first confusion, the Correspondence Principle, states that the behavior of a quantum system must approach that of a classical mechanical system in the limit of large quantum numbers. The view that makes mechanics the basis of the remaining branches of physics, and explains all physical phenomena by mechanical ideas, is in our judgment a prejudice. The mechanical theory of nature is, undoubtedly, in a historical view, both intelligible and pardonable; and it may also, for times have been of much value. But, upon the whole, it is an artificial conception. (Ernst Mach). There are many changes in concepts that are important when we go from classical to quantum mechanics… Instead of forces, we deal with the way interactions change the wavelengths of waves. (Feynman). Classical mechanics is an inappropriate starting point for physics because it is not fundamental; rather it is the limit of an incoherent aggregation of an enormous number of quantum elements." (C.E.p.6)

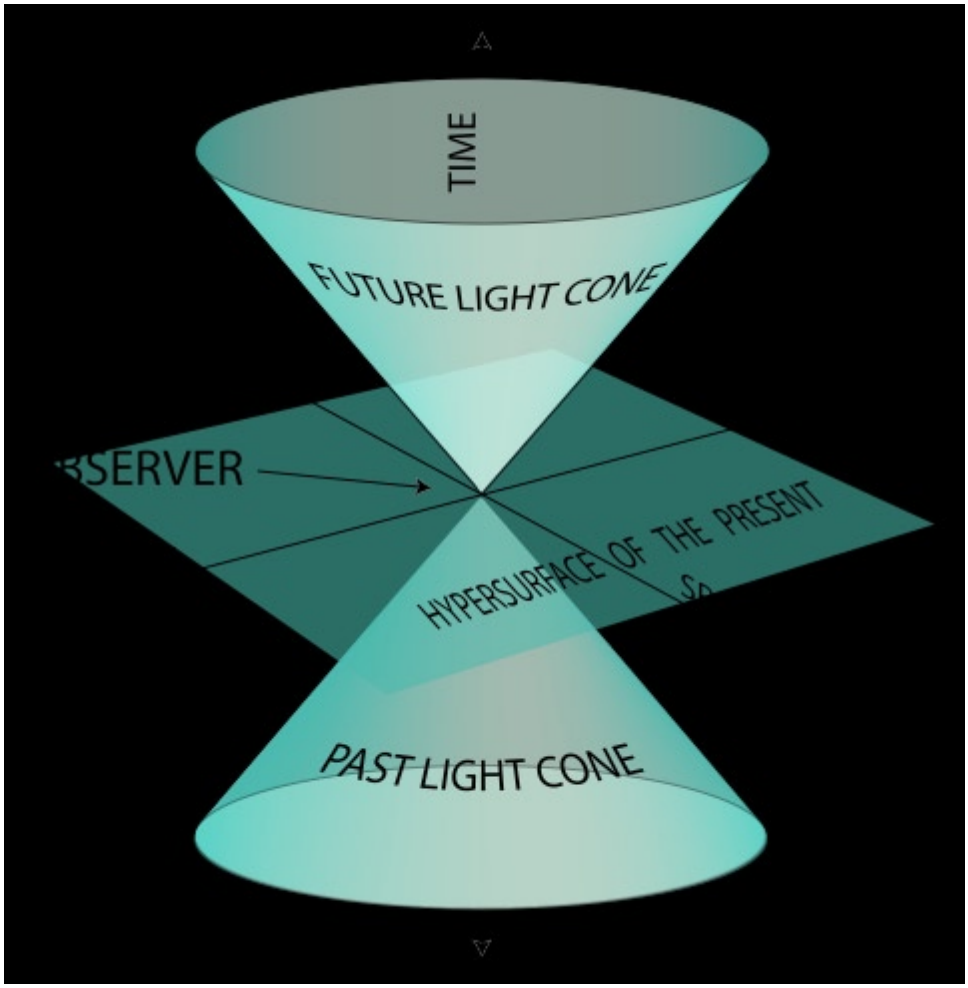


Figure 155. A worldline through a light cone in 2D space plus a time dimension. In special relativity, a light cone (or null cone) is the pattern describing the temporal evolution of a flash of light in Minkowski spacetime. This can be visualized in 3-space if the two horizontal axes are chosen to be spatial dimensions, while the vertical axis is time.[474]Credit: courtesy of Wikipedia.

More specifically in his great book, Dr. Mead uses the superconductor (figure156) as an example of "a quantum system on a grand scale, and, all by itself, provides us strikingly direct access to a near- perfect coherent state. It manifests all the quantum phenomena associated with the wave nature of matter, without the confusion about statistics..." (C.E.p.7). We notice that there is no need to introduce the notion of probability at any point in the discussion. The issue of probability comes up when we consider disordered systems where the phases of individual interactions are unknown. Statistical quantum texts are preoccupied with the question of which quantities are "measurable" and which are not--that question does not appear in the present discussion… (C.E.p.105) Following the tradition of Einstein and Schrodinger, the pioneers in this new endeavor, Jaynes, Cramer, Barut, Zeh, and others, have given us a great foundation: They have shown that traditional criticisms of this new approach are groundless. They have put us in a position to finally settle the Einstein-Bohr debate—with a resounding victory for Einstein. (CE. p.124) In general Dr. Mead proposes collective electrodynamics (the macroscopic wave-function of a coherent quantum system like the laser, a superconductor or the Bose-Einstein Condensate) as the correct starting point for the new physics, because it simplifies and unifies the knowledge base. His goal is to re-create quantum science with clarity and understanding by establishing it on the purity of a coherent foundation. In this sense, for the quantum practitioner or experimental physicists "the coherent state is taken as the starting point, and the statistics are put where Einstein would have placed them—in the random thermal excitations out of the perfectly coherent state. The success of this method can be viewed as a vindication of Einstein's conjecture… The coherent world has continuous wave functions, and abrupt-but-continuous quantum transitions."[475]

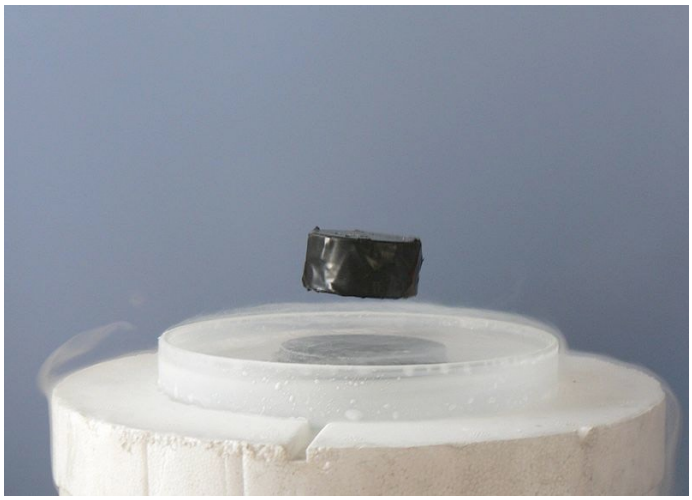


Figure 156. A magnet levitating above a high-temperature superconductor, cooled with liquid nitrogen. Persistent electric current flows on the surface of the superconductor, acting to exclude the magnetic field of the magnet (the Meissner effect). This current effectively forms an electromagnet that repels the magnet.[476] Credit: courtesy of Wikipedia.

Coherence according to Webster's dictionary comes from the Latin cohaerere which means co-together + haerere- to stick, that is to stick together. The act or condition of cohering; cohesion, the quality of being logically integrated or connected, consistent, and intelligible in speech and thought; congruity. Einstein loved symmetry and so his coherent legacy of the light reversed our awareness of the incoherent and asymmetrical legacy in this universe. In a quote from Feynman's Lectures on Physics, Mead, wrote, "Einstein was a giant, his head was in the clouds, but his feet were on the ground" (Collective Electrodynamics p.xix). By physically connecting our brains to Laser Technology, Science, Art and Philosophy, we are stimulating it with the creative light of Lasers so that we can truly understand where we come from, who we are and where we are going.

Yehuda Elkana in the book: **ALBERT EINSTEIN: Historical and Cultural Perspective** stated that "an astonishing coherence characterizes Einstein's psychology (that is, his attitude to people), his theory of mind, and his theory of the world… In all three areas, two dimensions coexist: the dimension of immediate sensations and the dimension of theoretical generalization. No logical bridge links the two. The certainty about the correctness of the theoretical dimension is assumed, since simplicity of the conceptual foundations has been secured. Then the fit with the experimental evidenced is sought… here the immediate level of experience is discontinuous and complex. With the help of simplifying order, we connect the fragments and create a continuum. The ordering and creation of a continuum is thinking… In all three processes we can observe the dialectical interplay between thema and antithema: simplicity versus complexity, and continuum versus atomicity. That which we can be aware of is fragmental, partial, and irreducible to more basic elements. That is, our world of awareness is atomistic and complex. The theoretical generalizations, on the other hand, are overarching, symmetrical, and expressible in very simple conceptual structures. The theoretical level is simple, intelligible and continuous. These generalized theories tolerate no asymmetries among natural phenomenon that should be symmetrical; no typically atomistic explanations such as action- at- a- distance are admitted; no statistical explanations are accepted as ultimate descriptions of reality.

Einstein posed another quantum challenge to the Copenhagen clan of quantum physicist lead by Niels Bohr. The foundational paper that illustrated the problem of the polarization of laser light was entitled "**Can quantum mechanical description of reality be considered complete? By Albert Einstein, B. Podolsky, and N. Rosen**.[477] This precious paper turned out to be the true foundation for the teleportation of mankind in the 21st Century.

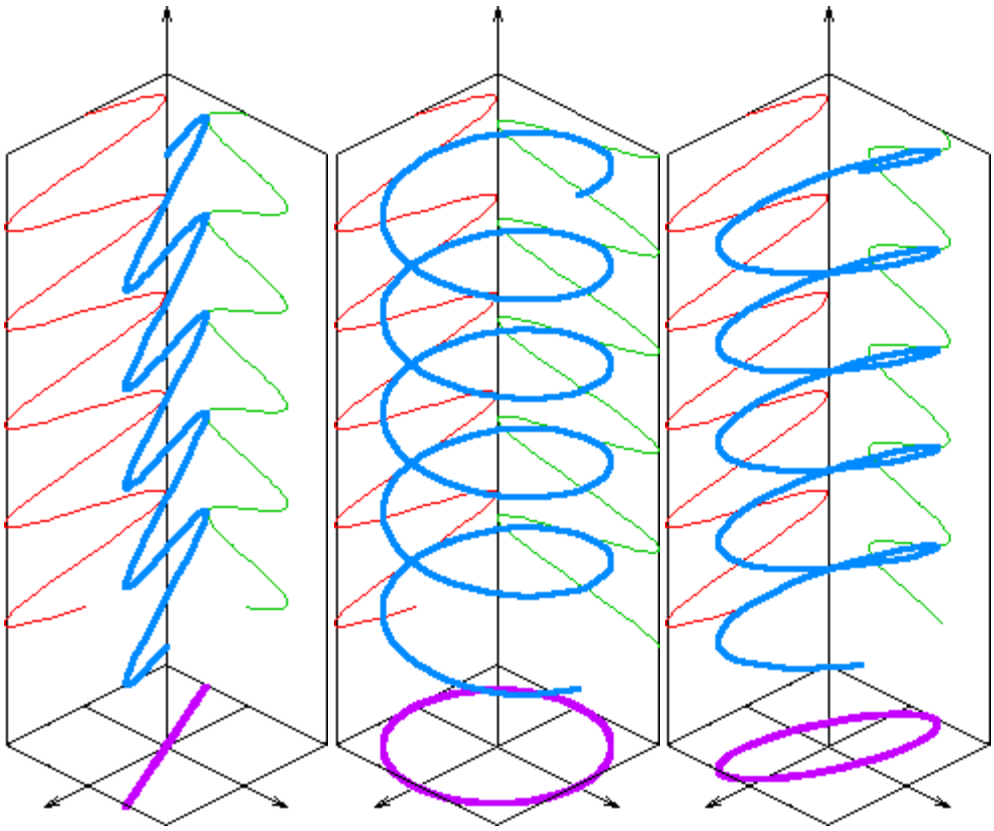


Figure 157. In the leftmost figure above, the two orthogonal (perpendicular) components are in phase. In this case the ratio of the strengths of the two components is constant, so the direction of the electric vector (the vector sum of these two components) is constant. Since the tip of the vector traces out a single line in the plane, this special case is called linear polarization. The direction of this line depends on the relative amplitudes of the two components. In the middle figure, the two orthogonal components have exactly the same amplitude and are exactly ninety degrees out of phase. In this case one component is zero when the other component is at maximum or minimum amplitude. There are two possible phase relationships that satisfy this requirement: the x component can be ninety degrees ahead of the y component or it can be ninety degrees behind the y component. In this special case the electric vector traces out a circle in the plane, so this special case is called circular polarization. The direction the field rotates in depends on which of the two phase relationships exists. These cases are called right-hand circular polarization and left-hand circular polarization, depending on which way the electric vector rotates. In all other cases, where the two components are not in phase and either do not have the same amplitude and/or are not ninety degrees out of phase, the polarization is called elliptical polarization because the electric vector traces out an ellipse in the plane (the polarization ellipse). This is shown in the above figure on the right. Credit: courtesy of Wikipedia.[478]

For the Editors of the Scientific American monthly magazine (March, 2003) and for the mathematician and science writer Amir D. Aczel, the technology of Teleportation (transportation via the coherent light of lasers) that resulted from the EPR document and its prophetic exhibition in the TV series Star Trek, is already a reality, at least for photons in the laboratories. In his book entitled; Entanglement: The Greatest Mystery in Physics (Published in 2002) Dr. Aczel illustrates with breathtaking historical knowledge how this mystery was unveiled. But there was one fundamental issue neither Dr. Aczel nor the Scientific American Magazine conveys in the report and it is namely the fundamental reason why Einstein and his collaborators wrote the paper in the first place. Which was to show that the statistical experiment or viewpoint does not give a complete picture of physical reality?[479]

It was again Carver Mead in his seminal book who gave me the best clarification of Einstein's fundamental perception of quantum physics in general and the EPR paradox in particular. "It is curious that Einstein, for whom Minkowski's four-dimensional space-time played such a central role, and who was generally convinced that time should play a symmetric role in the fundamental equations of physical law, took a strong position for local causality in three-space. The Copenhagen clan had come up with a mathematical formalism that could yield statistical results in accord with experiment--that was agreed by all. Were there more-fundamental physical laws beneath the statistical rules? Einstein thought there were, but Bohr said no, there was no deeper level to be understood. Einstein was still fuming about the whole thing in 1935, when he coauthored a paper with Podolsky and Rosen that took up the crusade once again.

The idea went as follows: Suppose an atom emits two photons simultaneously, as part of the same fundamental transition. The two photons travel in opposite directions, and have opposite polarizations. Once the photons have traveled far away, we measure the polarization of one, and thereby know the polarization of the other. So far, so good. But there are several ways to measure polarization. If we determine that one photon is right-hand circularly polarized, we know the other is left-hand. We can also ask if the first photon is linearly polarized along the y axis, in which case we know that the other is linearly polarized along the x axis. Now suppose we wait until after the photons have been emitted, and then quickly change the apparatus with which we measure the

polarization of one of them. Einstein was convinced that there is no way that the other photon can "know" that the first measurement had changed. When the experiment was carried out (as suggested by John Bell), it was indeed found to be true that the state of one photon depends on how the other is measured, a result that was immediately touted as a triumph for the Copenhagen view. From our present perspective, however, this result has nothing to do with which interpretation of quantum mechanics we use.

Cramer's transactional interpretation gives an even clearer picture of what is going on: The two photons are part of the same transaction, local in space-time. In three-space, we describe them by solutions propagating both forward and backward in time, as so elegantly put forth by Wheeler and Feynman. By now there are an enormous number of experiments for which forward and backward propagating solutions are by far the most economical explanation. These experiments effectively preclude the interpretation of photons as little bullets moving at the velocity of light and carrying energy as they go. But Einstein did not live to see these experiments completed, and his feelings about them were all tangled up with the statistical interpretation. So, although he strongly believed that time can run in both directions in fundamental physical law, he still held out for local causality in three-space. Causality is, however, not an idea that has roots in the fundamental laws of physics, but rather in thermodynamics."[480]

Einstein postulates his position; "there is no doubt that quantum mechanics has seized hold of a beautiful element of truth, and that it will be a test stone for any future theoretical basis, in that it must be deducible as a limiting case from that basis (space-time continuum), just as electrostatics is deducible from the Maxwell equations of the electromagnetic field or as thermodynamics is deducible from classical mechanics. However, I do not believe that quantum mechanics will be the starting point in the search for this basis, just as, vice versa, one could not go from thermodynamics (responsible for statistical mechanics) to the foundation of mechanics.[481]

The transactional interpretation of quantum mechanics (TIQM) is an unusual interpretation of quantum mechanics that describes quantum interactions in terms of a standing wave formed by retarded (forward-in-time) and advanced (backward-in-time) waves. The interpretation was first proposed by John G. Cramer in 1986. The author argues that it helps in developing intuition for quantum processes, avoids the philosophical problems with the Copenhagen interpretation and the role of the observer, and resolves various quantum paradoxes.[1][2] Cramer uses TIQM in teaching quantum mechanics at the University of Washington in Seattle.

The existence of both advanced and retarded waves as admissible solutions to Maxwell's equations was proposed by Richard Feynman and John Archibald Wheeler in 1945 (cited in original paper by J. Cramer). They used the idea to solve the problem of the self-energy of an electron. Cramer revived their idea of two waves for his transactional interpretation of quantum theory. While the ordinary Schrödinger equation does not admit advanced solutions, its relativistic version does, and these advanced solutions are the ones used by TIQM.

Suppose a particle (such as a photon) emitted from a source could interact with one of two detectors. According to TIQM, the source emits a usual (retarded) wave forward in time, the "offer wave", and when this wave reaches the detectors, each one replies with an advanced wave, the "confirmation wave", that travels backwards in time, back to the source. The phases of offer and confirmation waves are correlated in such a way that these waves interfere positively to form a wave of the full amplitude in the spacetime region between emitting and detection events, and they interfere negatively and cancel out elsewhere in spacetime (i.e., before the emitting point and after the absorption point). The size of the interaction between the offer wave and a detector's confirmation wave determines the probability with which the particle will strike that detector rather than the other one. In this interpretation, the collapse of the wavefunction does not happen at any specific point in time, but is "atemporal" and occurs along the whole transaction, the region of spacetime where offer and confirmation waves interact. The waves are seen as physically real, rather than a mere mathematical device to record the observer's knowledge as in some other interpretations of quantum mechanics.

John Cramer has argued that the transactional interpretation is consistent with the outcome of the Afshar experiment, while the Copenhagen interpretation and the many-worlds interpretation are not[3][482]

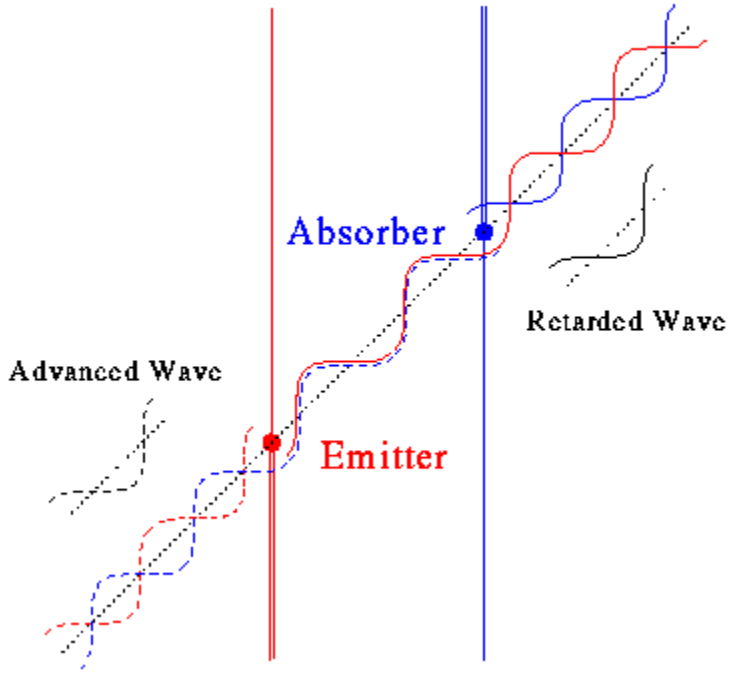


Figure 158.This figure illustrates a simplified form (one space dimension and one time dimension) of the transaction process. A plane-wave transaction between emitter and absorber through the exchange of advanced and retarded waves (see text). Waves from emitter are indicated by red lines and waves from absorber by blue lines. Retarded waves are shown as solid, and advanced waves are shown as dashed. Relative phase of waves is indicated schematically by sinusoids inscribed on light like world lines. Double time like world lines for emitter and absorber indicate higher energy state. Wave amplitudes have the value $\Psi+\Psi^*=2\mathrm{Re}(\Psi)$ at emitter and absorber loci and are therefore real.

There are two problems with the one dimensional plane wave description employed above: (1) it does not explicitly deal with the attenuation and modification of wave amplitude due to propagation through space or to passage through attenuating media; and (2) it does not explicitly include the quantum conditions on the transfer of energy, angular momentum, charge, etc., which are an important aspect of all quantum mechanical processes. In the case of quantum electrodynamics the photon energy quantization condition $E=\hbar\omega$ places an extra constraint on the electromagnetic wave equation, requiring that an integer number of quanta be exchanged between emitter and absorber despite the action of intervening space, filters, mirrors, slits, wave plates, etc., in reducing or modifying the amplitudes of the advanced and retarded waves exchanged between emitter and absorber.

For this reason, the two-step pseudo-time sequence {footnote 14} of Fig. 3 and the associated plane wave description must be replaced by a multi-step sequence allowing for spherical and more complicated wave forms and which proceeds until all relevant quantum conditions are met. In particular, we must view the transaction as occurring in pseudo-sequential form which includes an "offer", a "confirmation" and a completed transaction.

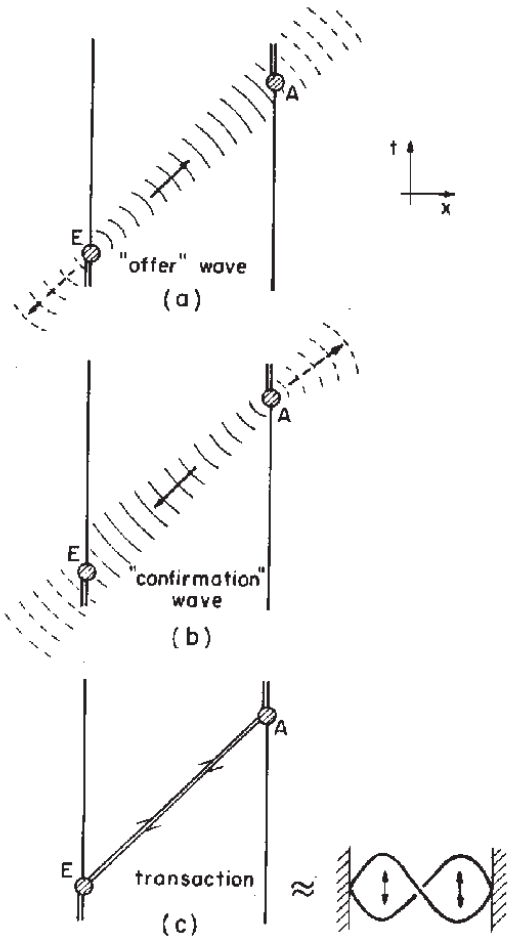


Figure 159. This figure illustrates this more general form of transaction. In the first pseudo-sequential step (1) the emitter located at (R1,T1), sends out a waves F1(r,t≥T1) and G1(r,t≤T) (which can be of spherical or more complicated form) in all possible spatial directions. In step (2) the absorber located at (R2,T2), receives the attenuated retarded wave front F1(R2,T2) and is stimulated to produce a response wave G2(r,t) which has an initial amplitude proportional to the local amplitude of the incident wave which stimulated.

It should be emphasized that the TI is an interpretation of the existing formalism of quantum mechanics rather than a new theory or revision of the quantum mechanical formalism. As such, it makes no predictions which differ from those of conventional quantum mechanics. It is not testable except on the basis of its value in dealing with interpretational problems. The author has found it to be more useful as a guide for deciding which quantum mechanical calculations to perform than to the performance of such calculations. As will be demonstrated in Chapter 4, the main utility of the TI is as a conceptual model which provides the user with a way of clearly visualizing complicated quantum processes and of quickly analyzing seemingly "paradoxical" situations (e.g., Wheeler's delayed choice experiments, Herbert's paradox, the Hanbury-Brown-Twiss effect, and the Albert-Aharonov-D'Amato prediction) which would otherwise require elaborate mathematical analysis. It is a way of thinking rather than a way of calculating. It may have value as a pedagogical tool for the teaching of quantum mechanics to students. It also seems to have considerable value in the development of intuitions and insights into quantum phenomena that up to now have remained mysterious. "

It is important to realize that the transactional model is atemporal, that is to say, that it is operating from what philosopher Huw Price designates as "the Archimedean standpoint or the view from nowhen," and nowhere above time and space. It was Prof. Price who illuminated my awareness of time with his great book: Time's Arrow and Archimedes' Point; New directions for the physics of time.[483] This book is concerned with a particular kind of question about time. What is the difference between the past and the future? Could---and does---the future affect the past? What gives time its direction, or "arrow"? Could time be symmetric, or a universe be symmetric in time? What would such a world be like? Is our world like that? The book is concerned with what modern physics has to say about issues of this kind, but I am not writing as a physicist, explaining the insights of my discipline to a general audience. I am a philosopher, and the vantage point of the book is philosophical. One of my main aims is to sort out some philosophical confusion in the answers that contemporary physicists typically give to these questions. I want to provide physicists themselves, as well as philosophers and general readers, with a clearer picture of these issues than has yet been available.

What are these philosophical confusions? The most basic mistake, I shall be arguing, is that people who think about these problems---philosophers as well as physicists---often fail to pay adequate attention to the temporal character of the viewpoint which we humans have on the world. We are creatures in time, and this has a very great effect on how we think about time and the temporal aspects of reality. But here, as elsewhere, it is very difficult to distinguish what is genuinely an aspect of reality from what is a kind

of appearance, or artifact, of the particular perspective from which we regard reality. I want to show that a distinction of this kind is crucial to the project of understanding the asymmetry of time. In philosophy and in physics, theorists make mistakes which can be traced to a failure to draw the distinction sufficiently clearly.The need to guard against anthropocentrism of this kind is a familiar theme in the history of both science and philosophy. One of the great projects in the history of modern thought has been the attempt to achieve the untainted perspective, the Archimedean view of reality---"the view from nowhere," as the philosopher Thomas Nagel calls it.[2] The main theme of this book is that neither physics nor philosophy has yet paid enough attention to the temporal aspect of this ancient quest. In particular, I want to show that if we want to understand the asymmetry of time then we need to be able to understand, and quarantine, the various ways in which our patterns of thought reflect the peculiarities of our own temporal perspective. We need to acquaint ourselves with what might aptly be called the view from nowhen...

Chapter 3 looks at the time asymmetry of a wide range of physical phenomena involving radiation. Why do ripples on a water surface spread outwards rather than inwards, for example? Similar things happen with other kinds of radiation, such as light, and physicists have been puzzled by the temporal asymmetry of these phenomena since the early years of the twentieth century. In discussing this issue, it turns out to be important to correct some confusion about what this asymmetry actually involves. However, the chapter's main focus will be the issue of the relation between this asymmetry and that of thermodynamics. I want to show that several prominent attempts to reduce the former asymmetry to the latter turn out to be fallacious, once the nature of the thermodynamic asymmetry is properly appreciated. In particular, I want to look at a famous proposal by the American physicists John Wheeler and Richard Feynman, called the Absorber Theory of Radiation. At first sight, this theory seems to involve the very model of respect for an atemporal perspective. I shall show that Wheeler and Feynman's reasoning is confused, however, and that as it stands, their theory doesn't succeed in explaining the asymmetry of radiation in terms of that of thermodynamics. However, the mathematical core of the theory can be reinterpreted so that it does show---as Wheeler and Feynman believed, but in a different way---that radiation is not intrinsically asymmetric; and that its apparent asymmetry may be traced, if not to the thermodynamic asymmetry itself, then to essentially the same source. (In effect, then, I want to show that Wheeler and Feynman produced the right theory, but tried to use it in the wrong way...

The last two chapters apply these lessons to the puzzles of quantum mechanics. Chapter 8 provides an informal overview of the long debate about how quantum mechanics should be interpreted, identifying the main positions and their advantages and disadvantages. As I'll explain, the best focus for such an overview is the question that Einstein took to be the crucial one about quantum mechanics: Does it give us a complete description of the systems to which it applies? Famously, Einstein thought that quantum theory is incomplete, and that there must be some further, more classical reality "in the background." His great disagreement with Niels Bohr centered on this issue. Einstein is often said to have lost the argument, at least in hindsight. (The work of John Bell in the 1960s is often thought to have put the final nail in Bohr's case, so to speak.) I think this verdict is mistaken. Despite Bell's work, Einstein's view is very much less implausible than it is widely taken to be, at least in comparison to the opposing orthodoxy."[484]

It was in Fred Hoyle's book; The Intelligent Universe, chapter 8, The Information-Rich Universe, section on: Living from Future to Past-- that I "found the most advanced formulation" of the time symmetric quantum vision given by Wheeler, Feynman and Mead. "Quantum mechanics is based on the propagation of radiation only from past to future, and as we have seen leads only to statistical averages, not to predictions of the nature of individual quantum events. Quantum mechanics is no exception to general experience in physics, which shows that the propagation of radiation in the past-to-future time-sense leads inevitably to degeneration, to senescence, to the loss of information. It is like leaving a torch switched on. The beam, initially bright, gradually fades away, and eventually it vanishes. But in biology this situation is reversed, because as living organisms develop they increase in complexity, gaining information rather than losing it. It is as if a torch could spontaneously collect light, focus it into a bulb, convert it into electricity and store it... If events could operate not only from past to future, but also from future to past, the seemingly intractable problem of quantum uncertainty could be solved. Instead of living matter becoming more and more disorganized, it could react to quantum signals from the future--the information necessary for the development of life. Instead of the Universe being committed to increasing disorder and decay, the opposite could then be true.

On a cosmic scale the effect of introducing information from the future would be similarly far reaching. Instead of the Universe beginning in the wound-up state of the big bang, degenerating ever since, an initially primitive state of affairs could wind itself up gradually as time proceeds, becoming more, not less sophisticated, from past to future. This would allow the accumulation of information--information without which the evolution of life, and of the Universe itself, makes no logical sense.The trouble we can now see with most of the fundamental questions about life and the origin of the Universe is that they are asked back-to-front. It is far less difficult to grapple with the issues in a future-to-past sense, because then we approach the ultimate cause instead of receding from it, the ultimate cause being a source of information, an intelligence if you like, placed in the remote future... However far we proceed into the future in looking for the ultimate source of the controlling signals, we are required to go still farther into the future, to eternity! Many of the religions of the world look at the future in a way similar to the one prompted by this insight into the information-rich Universe. The concept of eternity figures large in many of them, with the notion that there is a controlling force that lies at an unattainable distance. Perhaps here we have a vaguely perceived truth masked by the adornment of ritual and ceremony, obscured by the trappings of our earthly existence?" [485] On 11/03/2002, I had a profound convergence of thoughts regarding Einstein's coefficients for the Laser and a proportional hypothesis for perception using the VRD (a holistic theory of visual perception). Einstein, Carver Mead, John Cramer, Fred Hoyle, the time reversal paper by Feynman and Wheeler, Dr Wolf's wave structure of matter, Dr. Noltes Mind @ light speed and fusion and Geothermal sources of energy for our Laser Informed Eyes along with the connected laser infrastructure of the Lambdasphere became instantly unified by one conceptual space.

2.7 LaserFusion and Geothermal power for the Laser Empowered Home

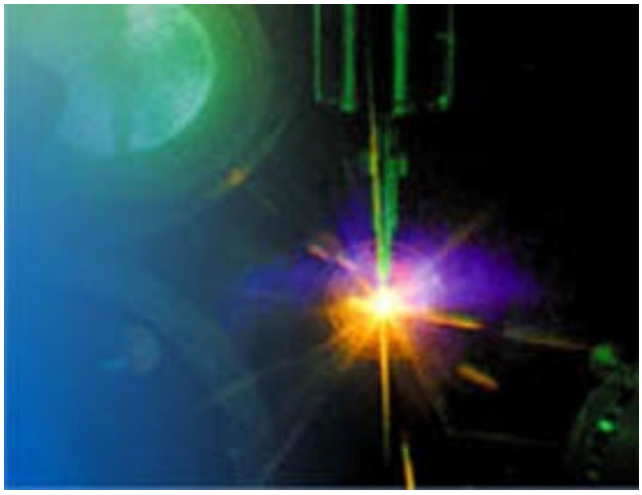


Figure 160. This was a miniature star created inside the Nova laser (ten laser beams) target chamber, delivering a pulse with a total peak power of 1015 watts (Petawatt). The radiant image of the Bose-Einstein structure of perception in laser light emerges from this creative act. What we are witnessing with this new laser star is truly the COSMOGENESIS of a new LaserEmpowered World derived from the coherent foundation of our universe. Photo courtesy of Laurence Livermore Laboratory

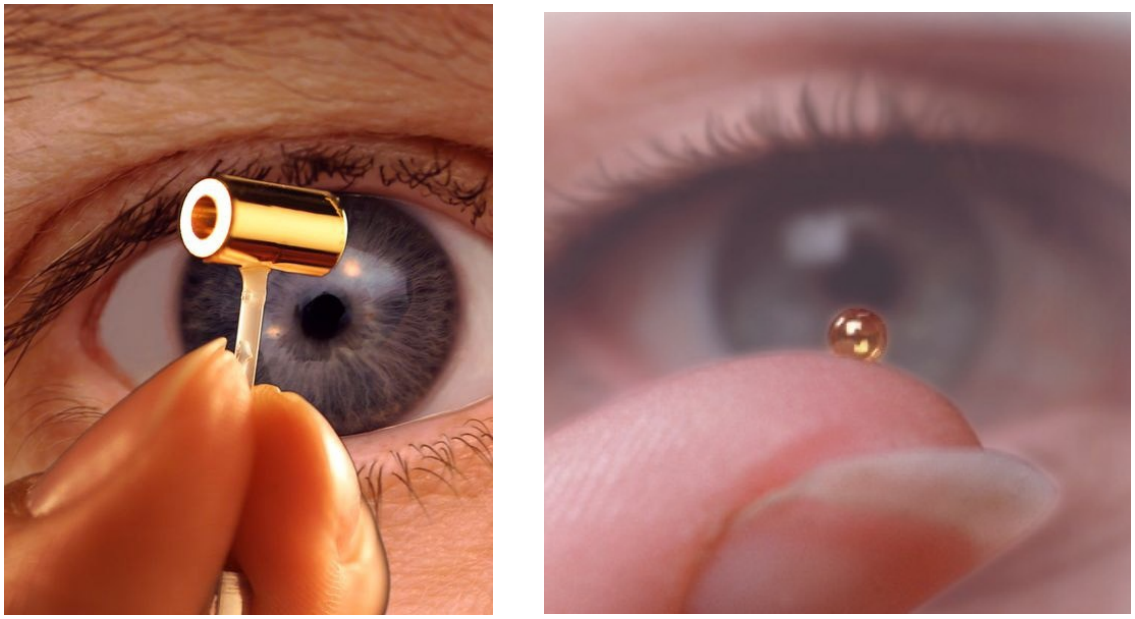


Figure 161. An inertial confinement fusion fuel microcapsule (sometimes called a "microballon" above right) of the size to be used on the NIF which can be filled with either deuterium and tritium gas or DT ice. The capsule can be either inserted in a hohlraum (as above left) and imploded in the indirect drive mode or irradiated directly with laser energy in the direct drive configuration. Microcapsules used on previous laser systems were significantly smaller owing to the less powerful irradiation earlier lasers were capable of delivering to the target. Credit: courtesy of Wikipedia.

In general the laser informed vision emerged from my bibliographic research project into the coherent foundation of our perception of the universe. More specifically, it became a search for the legitimate convergence between Einstein's scientific vision, the space-time continuum of light that provided the framework for his thinking and the multiplicity of applications that result from LaserFusion power. The LaserFusion power solution emerged from this search as the universal field of realization.

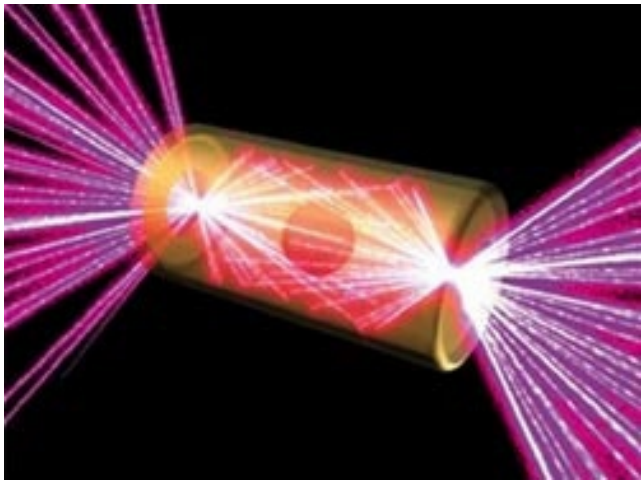


Figure 162. **Hohlraum –** German for "hollow space," a hohlraum is a hollow metal cylinder the size of a pencil eraser surrounding a fusion *fuel capsule*. In radiation thermodynamics, a hohlraum is defined as "a cavity whose walls are in radiative equilibrium with the radiant energy within the cavity." The hohlraum converts directed energy from either laser light or particle beams into X-ray radiation. The use of X-ray indirect radiation rather than laser light direct radiation provides additional options for compressing and heating the fuel capsule, or target, under the required conditions of *Inertial Confinement Fusion* (se*e Indirect-Drive Ignition in glossary*). Credit: courtesy of Laurence Livermore Laboratory.

All of the energy of NIF's 192 beams is directed inside a gold cylinder called a hohlraum, which is about the size of a dime. A tiny capsule inside the hohlraum contains atoms of deuterium (hydrogen with one neutron) and tritium (hydrogen with two neutrons) that fuel the ignition process.

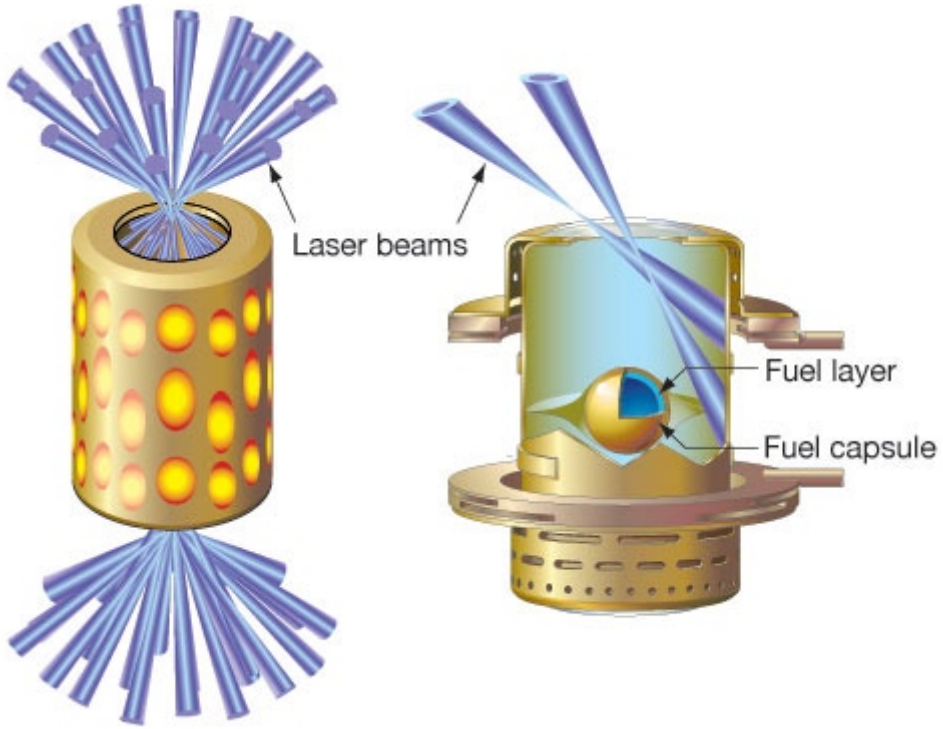


Figure 163.

Inertial Fusion Energy

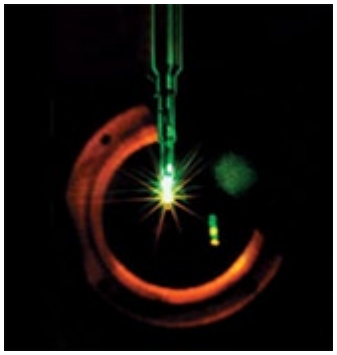


Figure 164. This miniature "star" was created in the target chamber of the Nova laser, NIF's predecessor, as 300 trillion watts of power hit a 0.5-millimeter-diameter target capsule containing deuterium-tritium fuel.

NIF's 192 intense laser beams will replicate the extreme conditions needed to achieve not only fusion ignition and burn, but also energy gain – two key milestones in the scientific pursuit of fusion energy as a source of electricity. If successful, NIF will be the first facility to demonstrate both phenomena in a laboratory setting. Determining the minimum input energy needed to start the fusion process is critical to determining the viability of inertial fusion energy. Thus NIF can provide the basis for evaluating future decisions about inertial fusion energy development facilities and programs.

Fusion, nuclear fission and solar energy (including biofuels) are the only energy sources capable of satisfying the Earth's need for power for the next century and beyond without the negative environmental impacts of fossil fuels. The simplest fusion fuels, the heavy isotopes of hydrogen (deuterium and tritium), are derived from water and the metal lithium, a relatively abundant resource. The fuels are virtually inexhaustible – one in every 6,500 atoms on Earth is a deuterium atom – and they are available worldwide. One gallon of seawater would provide the equivalent energy of 300 gallons of gasoline; fuel from 50 cups of water contains the energy equivalent of two tons of coal. A fusion power plant would produce no climate-changing gases, as well as considerably lower amounts and less environmentally harmful radioactive byproducts than current nuclear power plants. And there would be no danger of a runaway reaction or core meltdown in a fusion power plant.

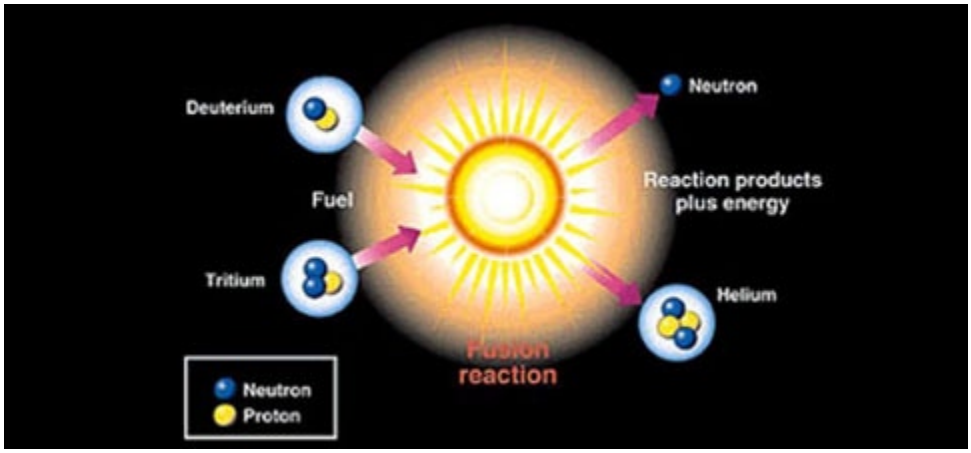


Figure 165. Credit; courtesy of Laurence Livermore Laboratory.

NIF is designed to produce fusion burn and energy gain using a technique known as inertial confinement fusion (see How to Make a Star). NIF's intense laser beams, focused into a tiny gold cylinder called a hohlraum, will generate a "bath" of soft X-rays that will compress a tiny hollow shell filled with deuterium and tritium to 100 times the density of lead. In the resulting conditions – a temperature of more than 100 million degrees Celsius and pressures 100 billion times the Earth's atmosphere – the fuel core will ignite and thermonuclear burn will quickly spread through the compressed fuel, releasing ten to 100 times more energy than the amount deposited by the laser beams. In a fusion power plant, the heat from the fusion reaction is used to drive a steam-turbine generator to produce electricity. NIF will not be used to generate electricity, for reasons discussed in How IFE Works. But NIF experiments should bring fusion energy a major step closer to being a viable source of virtually limitless energy by demonstrating fusion ignition and burn and energy gain in the laboratory. And the timing is fortunate: Energy experts estimate that over the next 75 years, the demand for energy could grow to as much as three times what it is today, while supplies of petroleum and natural gas will decline steadily and may well be exhausted by the turn of the century.

How IFE Works

In an IFE power plant, a few pulses of fusion energy per second would heat low-activation coolants, such as lithium-bearing liquid metals or molten salts, surrounding the fusion targets. These in turn would transfer the fusion heat to steam-turbine generators to produce electricity. Only a few NIF experiments can be conducted in a single day because the facility's optical components need time to cool down between shots. In an IFE power plant, targets will be ignited five to ten times a second. The requirement to operate at high pulse repetition rate (rep-rate for short) poses significant R&D challenges:

Target Performance

Experiments on NIF will demonstrate energy gain – the ratio of fusion energy from the ICF target divided by laser energy input – greater than ten. Advanced targets that can be tested on NIF after the initial ignition campaign begins in 2010 may achieve gains of 50 or more. For IFE, a target gain greater than about 100 is needed in order to minimize the portion of generated electric power that has to be recirculated within the plant to operate the laser. Fast ignition targets are expected to give gains of several hundred. A high recirculating power fraction means there is less power available for sale, so the cost of electricity will be higher.

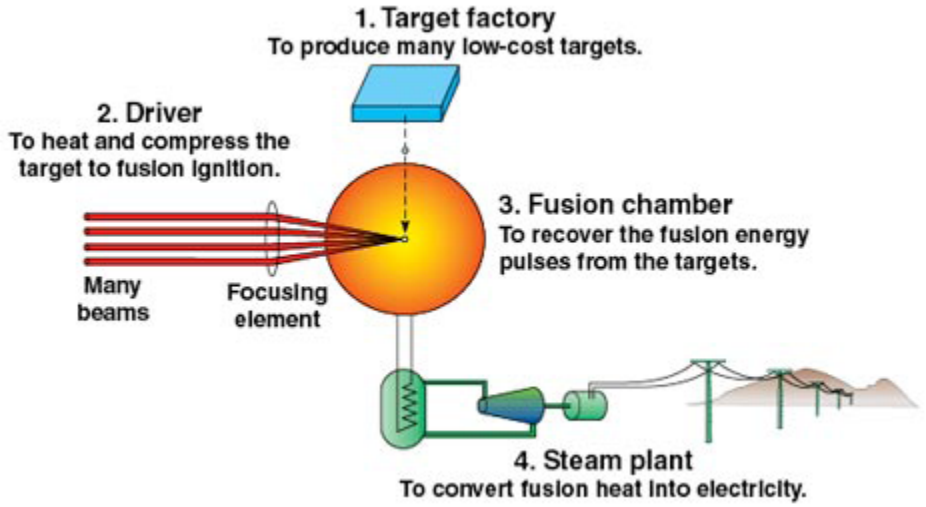


Figure 166. Credit: courtesy of Laurence Livermore Laboratory. An inertial fusion energy power plant consists of a target production facility (or target factory), target injection and tracking systems, the laser, a fusion chamber and a power conversion system.

Target Factory

The target factory must produce a continuous supply of high-quality targets at an acceptable cost – typically 25¢ for a target that produces 300 megajoules of energy. Many types of targets are being considered for laser IFE, including indirect-drive (like those that will be shot on NIF), direct-drive (currently being tested on the OMEGA laser at the University of Rochester),[486] and advanced designs including fast ignition and shock ignition (see Target Fabrication).

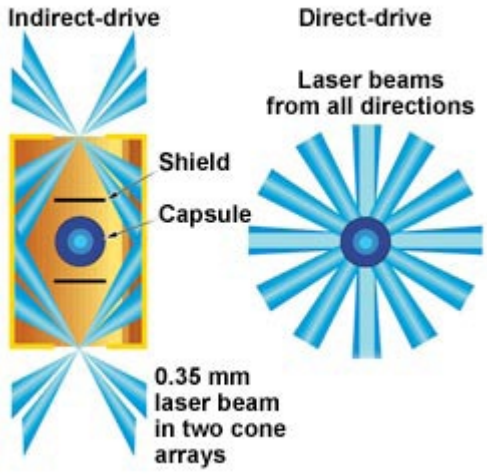


Figure 167. In all cases, the deuterium-tritium (D-T) fusion fuel is contained in a spherical fuel capsule. Near-term experiments planned for NIF will use capsules made of beryllium, carbon or carbon-hydrogen polymers, but for IFE plants, it is likely that polymer capsules will be the preferred material. The fuel capsule must be cold enough for D-T to freeze and form a layer of D-T ice on the inner wall of the capsule.

In direct-drive, the capsule is directly irradiated by the laser beams. In indirect-drive, the capsule is placed inside a hohlraum, a tiny, can-shaped container made with high-atomic-mass materials like gold and lead with holes on the ends for beam entry. If the power plant operates at five shots a second, the target factory will have to produce more than 400,000 targets a day. Detailed conceptual design studies for IFE target factories have been completed by General Atomics, a participant in the National Ignition Campaign.

Target Physics

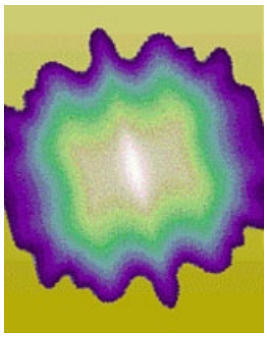


Figure 168. Researchers use Livermore´s LASNEX code to model the target physics. The code is used to produce simulated data, such as this neutron image, which will be compared with data from NIF experiments **Executing a target shot at the National Ignition Facility** requires the collaborative expertise of target designers, experimental physicists, laser and materials scientists and engineers. The designers have to work with the experimentalists to set the goals for each experiment and to establish target, traget daignostic and laser specifications accordingly. Livermore researchers are guided by increasingly detailed modeling that uses the latest generation of supercomputers. The modeling must account for a variety of physical phenomena that occur during an implosion and resulting ignition.

The simulations study the physics of both laser-driven hohlraums and capsule implosions. The study of hohlraums includes the refraction, reflection and absorption of laser light passing through the hohlraum's laser entrance holes, the interaction of the laser light with low-density plasma, the conversion of absorbed laser light into X-rays, the flow of those X-rays within the hohlraum and their absorption onto the ablator layer. Capsule physics encompasses the variation of the capsule ablation, implosion and hydrodynamic instability growth and mixing within the capsule and the thermonuclear burn of the deuterium-tritium fuel.

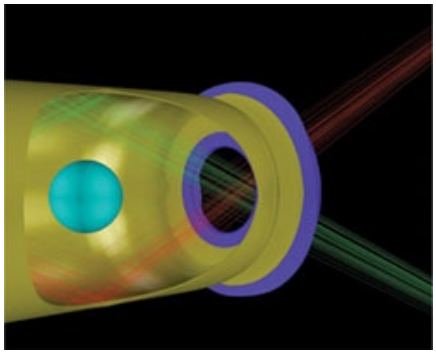


Figure 169. Livermore's radiation hydrodynamics code HYDRA was used to simulate a two-millimeter-diameter ignition target for NIF. This cutaway view shows representative laser rays from two beams (green, red) as they illuminate the hohlraum wall (gold). Their energy is converted to thermal X-rays, which heat the capsule ablator.The simulations reflect certain experimental realities: Implosion is an inherently unstable process, and ignition experiments on NIF will involve neither perfectly smooth and spherical capsules nor a perfectly uniform field of X-rays to ablate the outer layer and compress the fuel inside (see How to Make a Star). Several Livermore-developed codes are used because no single code can simultaneously model all ignition phenomena. LASNEX is a venerable two-dimensional radiation hydrodynamics code with very complete modeling of most relevant physical processes. Researchers use LASNEX to model the full geometry of the hohlraum and capsule as well as the incident laser beam. In these simulations, called integrated modeling, the capsule, hohlraum and laser light are modeled simultaneously.

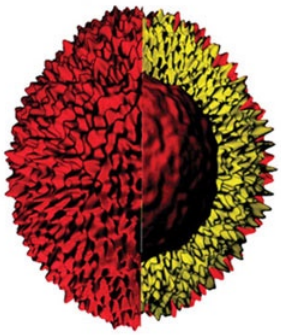


Figure 170. These density isosurfaces from a HYDRA simulation of a NIF ignition capsule show the irregularities that result from Rayleigh-Taylor instabilities. The outer surface is near the ablator-fuel interface, and the inner surface is in the deuterium-tritium fuel. At 140 picoseconds before ignition time, the ignition capsule has a density of 60 grams per cubic centimeter and a diameter of 100 micrometers at maximum implosion velocity. HYDRA is a three-dimensional radiation hydrodynamics code that contains all the physics necessary for imploding NIF ignition capsules. HYDRA can simulate the entire ignition target in 3D, including the hohlraum, capsule and all relevant features. The code is flexible enough to model intrinsic asymmetries that result from the ideal laser illumination pattern and those that result from effects of irregularities in laser pointing and power balance. It also simulates the hydrodynamic instabilities that occur when the capsule implodes. HYDRA calculates all of the radiation, electron, ion and charged-particle transport and the hydrodynamics from first principles – that is, no adjustments are made to the modeling parameters.

These simulations allow scientists to evaluate the robustness of a target design. For example, a designer can place realistic roughness on the capsule surfaces and calculate how these features evolve into irregularities – bubble and spike patterns – as a result of hydrodynamic instabilities. Three-dimensional simulations indicate that the ultimate amplitudes of the bubbles and spikes are greater than are shown in the 2D simulations. Thus, the 3D calculations provide more accurate information on peak amplitudes of these irregularities and how they affect target performance.

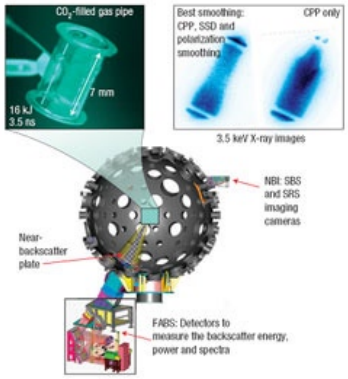


Figure 171.This schematic diagram shows a laser beam propagation experiment modeled with the pF3D code. Images at the upper right show the X-ray emission in the plasma. When all three beam-smoothing methods were used (continuous phase plates, or CPP, smoothing by spectral dispersion, or SSD, and polarization smoothing), there was full propagation of the beam. When only CPP was used, the beam stalled before propagating all the way to the center of the target. Designers are also using HYDRA to evaluate alternative target designs, including one with two concentric spherical shells and direct-drive targets that eliminate the need for a hohlraum (See How ICF Works). The HYDRA development team continues to enhance the code's capabilities in response to user requests. One new physics package will treat magnetic fields in 3D, further improving understanding of the target physics.

Other codes model in detail the laser-plasma instabilities (see Plasma Physics and ICF). A principal code for this application is pF3D, which simulates the interactions of the laser light with the electrons and ions in the plasma. NIF Early Light experiments have been modeled with extraordinary high fidelity using the pF3D code on Livermore's massively parallel supercomputers. The results, showing the effects of four NIF lasers pointed at high energy on a full-scale target for the first time, are a forerunner to full-scale experiments in 2008 using 96 beams (see "Simulations of early experiments show laser project is on track" (PDF). The success at creating a computerized view of the fusion experiment might be compared to looking "in the back of the book" since the computations were carried out on LLNL's supercomputers using the pF3D laser-plasma interaction code after the actual experiment was done. The calculations helped understand and explain what occurred. The agreement bodes well for doing more predictive modeling in the future.[487]

Fusion Chamber

Each fusion target releases a burst of fusion energy in the form of high-energy (14-million-electron-volt) neutrons (about 70 percent of the energy), X-rays and energetic ions. Experiments at the National Ignition Facility will help clarify whether it is economically feasible to generate electricity by laser fusion. The fusion chamber must contain this blast of energy and convert the sequences of energy pulses into a steady flow of power for the power conversion system. The chamber design must include a 50- to 100-centimeter-thick region that contains lithium (as a liquid metal, molten salt or solid compound) in order to produce tritium through nuclear reactions with the fusion neutrons. This region is called the breeding blanket and must produce at least one tritium atom for every tritium atom burned in the fusion target – a tritium breeding ratio equal to or greater than one. A key issue for the chamber is the survival of the innermost wall (first wall) that is exposed to intense heat and radiation from the target's X-rays, ions and neutrons.

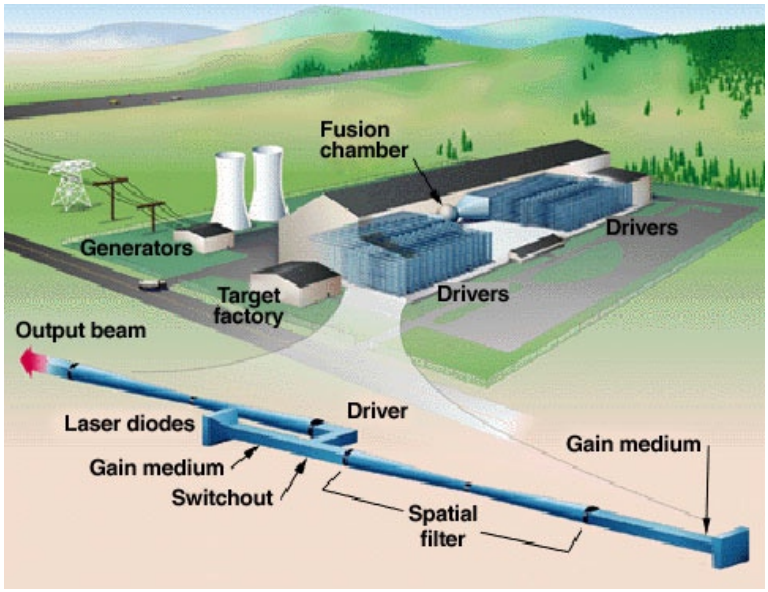


Figure 172. An artist's rendition of a laser fusion power plant driven by diode-pumped solid-state lasers. Credit: courtesy of Laurence Livermore Laboratory.

Laurence Livermore Lab helps Texas Laser blaze to Petawatt power milestone

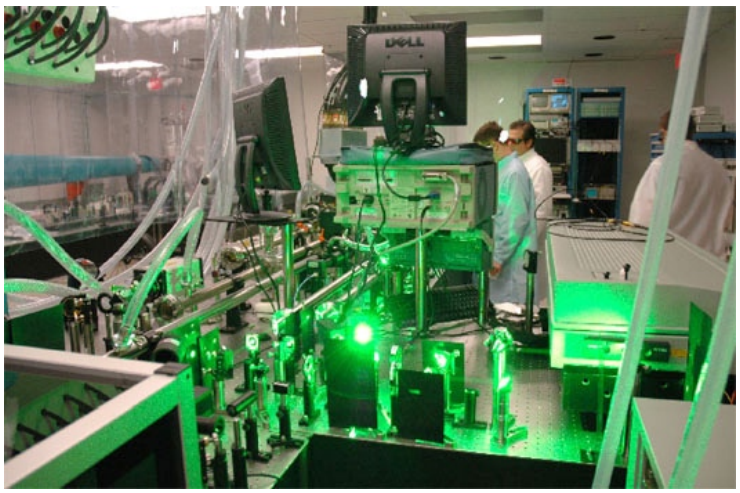


Figure 173. The front end of the Texas Petawatt. Using optics and expertise developed at LLNL, a laser at the University of Texas has demonstrated more than one quadrillion (1,015) watts (one petawatt) of power. The Texas Petawatt laser is the first of its kind to be completed in the United States since the deactivation of the original petawatt laser at LLNL in 1999. So if according to Scientific American a 100 Million Dollar Laser of 1995 is in 2005, $1 Million, it is then reasonable to estimate that we can now get the equivalent power for 1% of the cost.[488] Credit: courtesy of Laurence Livermore Laboratory.[489]

According to Todd Ditmire of the Texas Center for High Intensity Laser Science, the Texas Petawatt is now the highest-power operating laser in the world. Ditmire thanked LLNL Principal Associate Director Ed Moses and members of the National Ignition Facility and Photon Science Principal Directorate for their help in achieving the milestone. “We couldn’t have done it without the help of LLNL and the NIF people,” Ditmire said.

The Texas Petawatt laser achieved its power milestone by amplifying a laser pulse to an energy of 190 joules and compressing this energy to a pulse duration of less than 170 femtoseconds (a femtosecond is one quadrillionth of a second). The Texas Petawatt currently is the only laser producing more than a petawatt of power in the United States and only the second such laser constructed worldwide since the first petawatt laser was completed and deactivated at Livermore in the late 1990s (the other such laser is the Vulcan laser at the Rutherford Appleton Laboratory in the UK). A petawatt is 2,000 times the power output of the entire U.S. electrical grid.

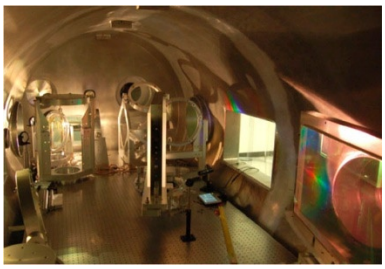


Figure 174.The vacuum compressor of the Texas Petawatt showing the large dielectric gratings in place.

The Texas Petawatt uses the same concept as the original petawatt laser built on the NOVA laser at the Laboratory. It takes a short, low-energy laser pulse, stretches it in time by a factor of about 10,000, and amplifies it. It then compresses the final, amplified pulse back down to a duration near that of the initial laser pulse. This technique, known as “chirped pulse amplification,” is used in many of the world’s highest-power lasers, including the Titan laser at LLNL. While based on concepts similar to the initial petawatt laser on NOVA, the Texas Petawatt uses a number of new technologies, which allow it to compress its laser pulses to shorter time durations than the NOVA petawatt, and thereby access petawatt power levels at lower energies than the original petawatt laser.

Ditmire said LLNL was a critical collaborator on the Texas Petawatt project. LLNL scientists from the NIF and Photon Science Principal Directorate assisted the technical team from the University of Texas in the development of many of the laser’s key components. LLNL staffers also played an important role in providing project management guidance for aspects of the project. The final amplifiers of the Texas Petawatt are neodymium, glass amplifiers from the NOVA laser, allocated to the University of Texas after NOVA was shut down. LLNL has played a major role in the refurbishment and activation of these amplifiers. The large gratings needed to compress the Texas Petawatt pulse were also fabricated at LLNL, an optical capability unique to the Lab, Ditmire said.

The Texas Petawatt will be used for fundamental experimental studies of high-energy density plasmas. This includes making plasma states with temperatures exceeding those of fusion plasmas, such as those found in the sun, or pressures exceeding a billion Earth atmospheres. This will allow exploration of the properties of plasmas not usually accessible in university laboratories. The Texas Petawatt also will allow study of many astrophysical phenomena in miniature, such as the explosion of supernovae, the formation of galactic jets, or the properties of matter found in dense stars such as brown dwarfs. The Texas Petawatt also can be used to study aspects of the “fast ignition” approach to inertial confinement fusion, which is aimed at achieving a rapid repetition rate for laser shots in order to make laser fusion energy commercially feasible.

Much of this scientific program will be pursued in collaboration with researchers from National Nuclear Security Administration (NNSA) labs, including scientists from the Lab’s NIF and Photon Science Principal Directorate and the Physical Sciences and Chemistry, Materials, Earth and Life Sciences directorates.

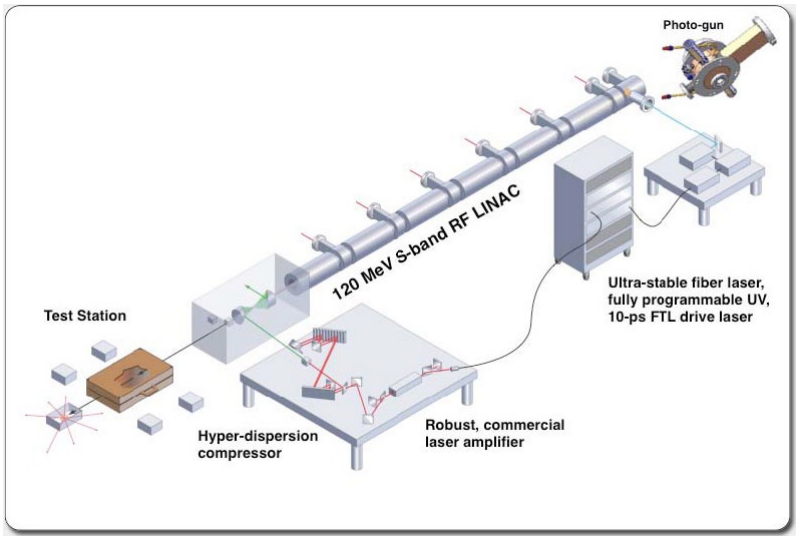


Figure 175.

The Texas Center for High Intensity Laser Science is a Stewardship Science Academic Alliance Center of Excellence funded by NNSA. The primary mission of the Texas Petawatt will be to train students in the core areas of high-energy density (HED) physics and ultimately prepare them for work on the large NNSA laser machines. As such, the Texas Petawatt serves as a smaller-scale complement to the NNSA's suite of large-scale HED machines such as the National Ignition Facility, the Z Machine at Sandia National Laboratories and the OMEGA laser at Rochester University's Laboratory for Laser Energetics.

Ditmire wrote his Ph.D. thesis in applied science for UC Davis while working at LLNL from 1991 to 1995. He graduated magna cum laude from Harvard University in 1991 with a master's degree in physics and art history and earned his master's degree in applied science at UC Davis in 1993. Ditmire worked at Imperial College of Science, Technology and Medicine in London from 1995-1997, then returned to LLNL where he was project leader for the Falcon laser project until 2000.

The Petawatt Laser and the Photonics Powerline Home Network

Just as the Laser Fusion Star model is currently being developed at the National Ignition Facility (NIF) within the Laurence Livermore Laboratory in California, USA, a similar model is being developed at the Laser Megajoule facility in France. A magnetic approach to fusion power is also being developed at the International Thermonuclear Fusion Experimental Reactor (ITER) in France. These laser fusion star models are currently very big (NIF is 3 football stadiums wide), but with the exponential advances in nano-photonics it will be a personal reality within the next 30 years. Recently in Europe, the HiPER Laser fusion model has emerged and it looks very promising! According to this group, "demonstration of fusion energy production using a laser is now anticipated in 2010." HiPER is being designed to enable a broad array of new science including extreme material studies, astrophysics in the laboratory, miniaturized particle accelerators and a wide range of fundamental physics research. Fusion energy is an attractive, environmentally clean power source using sea water as its principal source of fuel. No greenhouse gases and long-lived radioactive waste are produced. Demonstration of the scientific proof of principle is expected between 2010 and 2012 as part of an ongoing international program. What is now needed is to move from the scientific proof of principle stage to a commercial reactor. HiPER provides the critical next step along this route.

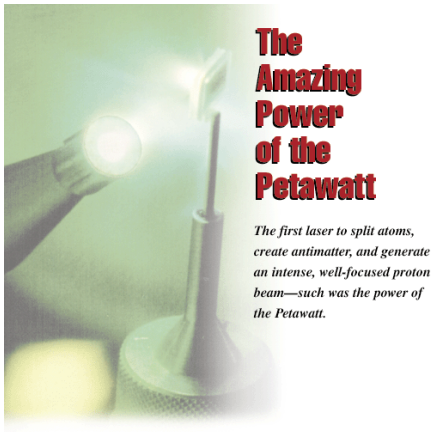


Figure 176. The Petawatt laser achieved a focused power density approaching 1021 W/cm2 (almost a sextillion watts of energy concentrated on a square centimeter) and an energy density of 30 billion joules in a cubic centimeter-far exceeding the energy density inside stars.1 Credit: courtesy of Laurence Livermore Laboratory.

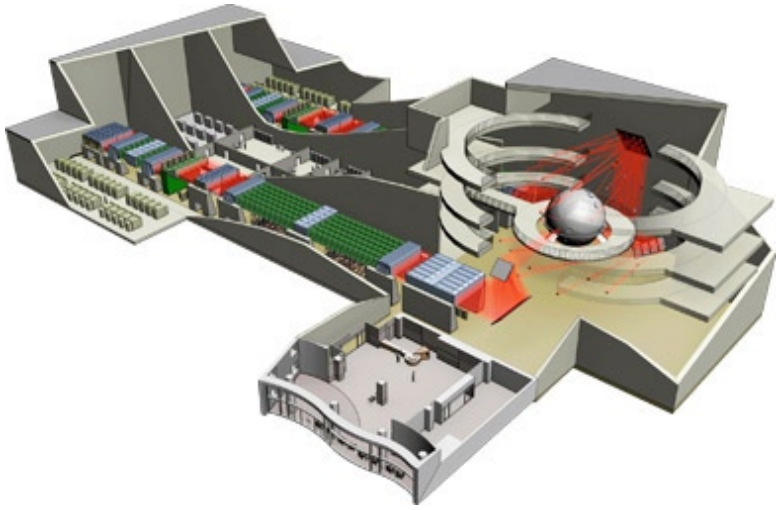


Figure 177. HiPER is a proposed European **Hi**gh **P**ower laser **E**nergy **R**esearch facility dedicated to demonstrating the feasibility of laser driven fusion as a **future energy source**. Credit: courtesy of Wikipedia.

The High Power laser Energy Research facility (HiPER), is an experimental laser-driven inertial confinement fusion (ICF) device undergoing preliminary design for possible construction in the European Union starting around 2010. HiPER is the first experiment designed specifically to study the "fast ignition" approach to generating nuclear fusion, which uses much smaller lasers than conventional designs, yet produces fusion power outputs of about the same magnitude. This offers a total "fusion gain" that is much higher than devices like the National Ignition Facility (NIF), and a reduction in construction costs of about ten times.[490] 2 The PETAL (PETawatt Aquitaine Laser) laser, located in the Aquitaine region of France, will be a fore-runner to the HiPER facility to address physics and technology issues of strategic relevance to HiPER.[491] 3 A Petawatt (1015 watts) =

- 1.25 PW - tech: world's most powerful laser pulses (claimed on 23 May 1996 by Lawrence Livermore Laboratory).
- 1.4 PW - geo: estimated heat flux transported by the Gulf Stream.
- 4 PW - geo: estimated total heat flux transported by earth's atmosphere and oceans away from the equator towards the poles.
- 174.0 PW - astro: total power received by the earth from the sun

Staring in the late 1980s a new method of creating very short but very high power laser pulses was developed, known as chirped pulse amplification, or CPA. Starting in 1992, LLNL staff modified one of Nova's existing arms to build an experimental CPA laser that produced up to 1.25 PW. Known simply as Petawatt, it operated until 1999 when Nova was dismantled to make way for National Ignition Facility (NIF). Livermore's Petawatt laser operated for three years, until its last shot was fired on May 27, 1999. At full

energy of about 680 joules, the shots delivered more than a quadrillion watts (or petawatt, which equals 1015 watts) of power, exceeding the entire electrical generating capacity of the U.S. by more than 1,200 times. But the Petawatt's shots lasted for just a fleeting moment-less than a trillionth of a second, or 440 femtoseconds to be precise.

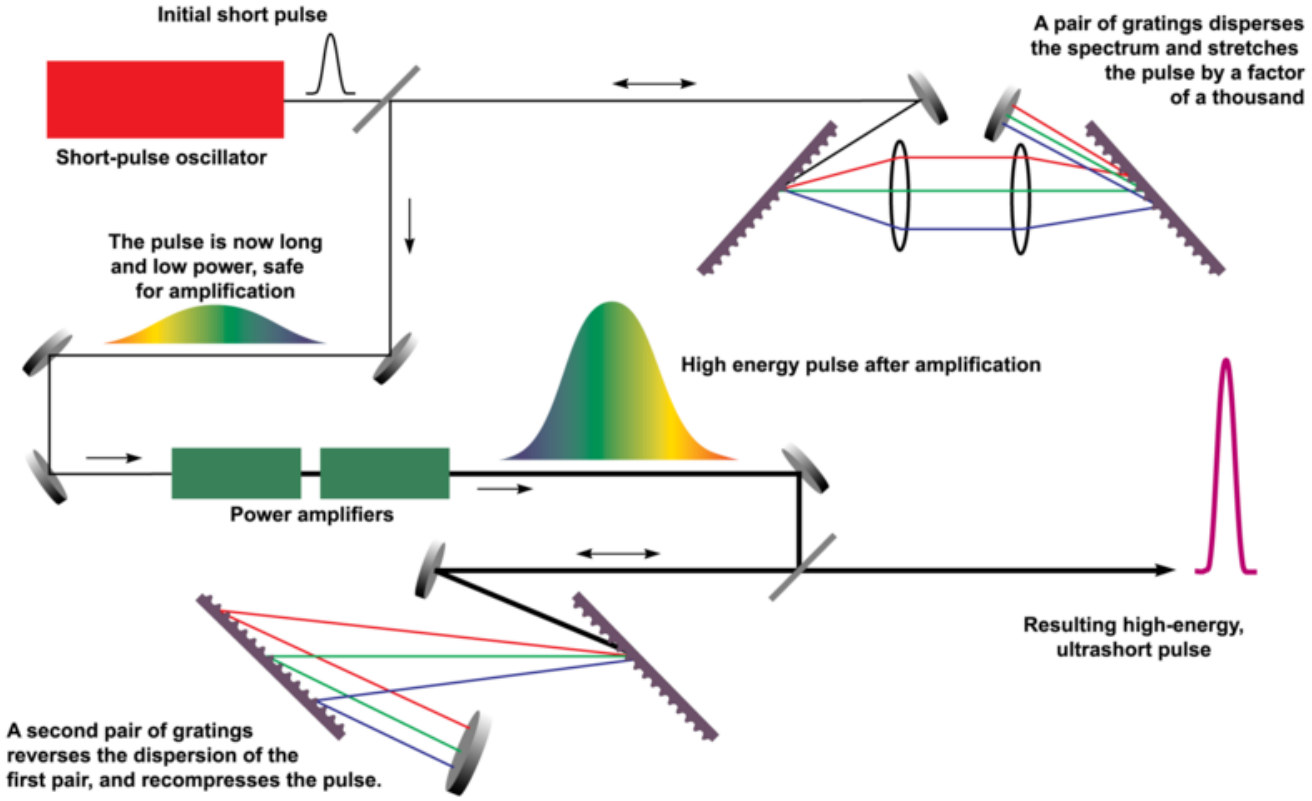
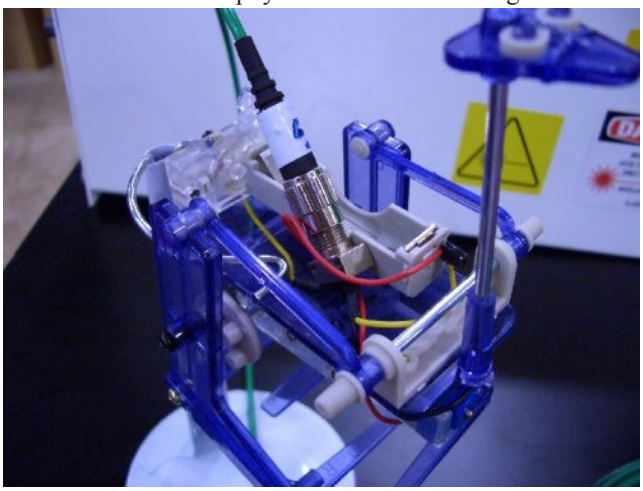


Figure 178. Diagramatic scheme of chirped pulse amplification. Credit: courtesy of Wikipedia.

The Petawatt laser was developed originally to test the fast ignition path to inertial confinement fusion in the ongoing attempt to ignite a pellet of hydrogen fuel and harness the energy that powers the sun. The power of the Petawatt also opened up entirely new physical regimes to study. Now scientists can use lasers, not just particle accelerators, to study high-energy-density physics and the fundamental properties of matter. They may also be able to recreate in the laboratory the energized plasmas around black holes and neutron stars for astrophysical research. Although Petawatt was instrumental in advancing the practical basis for the concept of "fast



ignition fusion", by the time it was operational as a proof-of-concept device, the decision to move ahead with NIF had already been taken. When Nova was being dismantled to make way for NIF, the target chamber was lent to France for temporary use during the development of Laser Megajoule, a system similar to NIF in many ways. This loan was controversial, as the only other operational laser at LLNL at the time, Beamlet (a single experimental beamline for NIF), had recently been sent to Sandia National Laboratory in New Mexico. This left LLNL with no large laser facility until NIF started operation, which was then estimated as being 2003 at the

earliest. NIF is still not completely operational in 2007.[4] Further work on the fast ignition approach continues, and will potentially reach a level of development far in advance of NIF at HiPER, an experimental system under development in the European Union. If successful, HiPER should generate fusion energy over twice that of NIF, while requiring a laser system of less than one-quarter the power and one-tenth the cost. Fast ignition is one of the more promising approaches to fusion power.[492]

Here we also illustrate how the Laser Petawatt fusion system will be connected to and managed by the Microvision VRD. Because Microvision partnered with the info-technology industry as a whole they enabled the connection of the VRD to the Home Technology Integration (HTI) system.[493] By integrating the VRD to HTI, Microvision stimulated the emergence of the LaserEmpowered Home.[494] You shall see how the most powerful laser light source in the universe will be distributed through a global photonics power line network (PPLN); laser power, video, audio and data over fiber and free space optics. This section integrates the laser's cosmic power into our smart homes. Here we announce the advent of the Petawatt laser for the photonic power line home network (PPHN). Here we specify how the LaserEmpowered HTI System will be installed, configured and powered by the Petawatt tabletop Laser star system. We will also show how it will be distributed via the photonic powerline network from JDS Uniphase.[495] You will recognize the quadruple play of the laser. In addition to the triple play (video, audio and data over the internet) offered by telecom carriers like Verizon Fios (fiber optics to the home),[496] 4 the quad play now includes laser power transmission over the same fiber optics lines.[497] 5 Photonic power has evolved and accelerated the development of our capacity to harness clean laser energy. In fiber optics and free space optics lasers are converted into electricity and back into laser. This new development is creating the new infrastructure for the future power grids. Photonic power is truly the new foundation upon which the global internet ecosystem will be delivered in the near future. We will show you in clear visual form how this quad play will serve as the foundation for our laser educational mission.

Our main goal is to show you how to effectively integrate this new laser intelligence into your brain. Educate your visual cognition and prepare you for participation in the Laser Empowered world. Our final objective is to show you how through the free space optics of the VRD and the photonic powerline (fiber optic quad play) connection, your visual education can be augmented and MIT's superpower knowledge base integrated into your home. Telecommuting for study and work around the world will explode and participation in this global technology will be universal. Running in parallel to NIF's fusion approach, the Laser Megajoule (60 powerful lasers will ignite a tritium and deuterium pellet) project is a major component of the French simulation program designed to study nuclear fusion by inertial confinement. The future Laser Megajoule facility requires control-command systems that will operate in a harsh radiative environment. Commercial off-the-shelf optical fiber data links are envisaged as a radiation tolerant solution for this application.[498]

Figure 179 Laser Megajoule project in France. Credit: courtesy of Wikipedia.

The Laser Megajoule will be the most powerful laser in the world, allowing for fundamental research and development of lasers and plasma technologies. This project, carried by the French Ministery of Defence, involves an investment of 2 billion euros.[499] In 2009, the 600 experiments programmed each year with the Laser Mégajoule will begin. The "**Road of the lasers**", a major project of regional planning for the optical and lasers industries, will be born. Therefore, the area of Bordeaux will shelter the most important concentration of optical and laser experts in Europe.[500] By 2010, in parallel to the Texas Petawatt laser, HYPER's fast ignition, the French Laser Megajoule project and the National Ignition Facility's all 192 laser beamlines are expected to be ignited producing our own home grown coherent sun! And what is the best infrastructure for the global delivery of this awesome power? You guessed it, it is fiber optics. As you saw above the French are adapting optical fibers for command and control because they are radiation tolerant. But more importantly, fiber optics is not only heat tolerant it is also a transducer, it converts laser light into power and back into laser signal as video, audio or data.

Perhaps the most important reason in favor of the fiber optic infrastructure for the LaserEmpowered world is the upcoming revolution in the power grid. In 2004 the U.S. Federal Communications Commission adopted rule changes that allow utility companies to provide broadband over powerlines, fostering greater competition among high-speed Internet providers. This grand opportunity for power companies will further stimulate the adoption of fiber optics in the energy sector, introducing what I call the quadruple play of services, broadband power, video, audio and data over fiber (Pof).[501] A growing number of power companies are already providing fiber optic services on a global scale. According to Fiber Planners the utility companies are in the best position to deliver this service because they already own most of the right of way and have universal connection to all homes. They also have the advantage of using one of the most powerful types of optical fibers available called optical ground wire or OPGW. Once ITER, HYPER, NIF and the Laser Megajoule unleash the clean cosmic laser unto the global optical fiber power grid we can envision a healthier greener planet. We can literally clean up the planet from all that fossil fuel and political pollution. And truly bring health, wealth and freedom to every LaserEmpowered Home![502]t

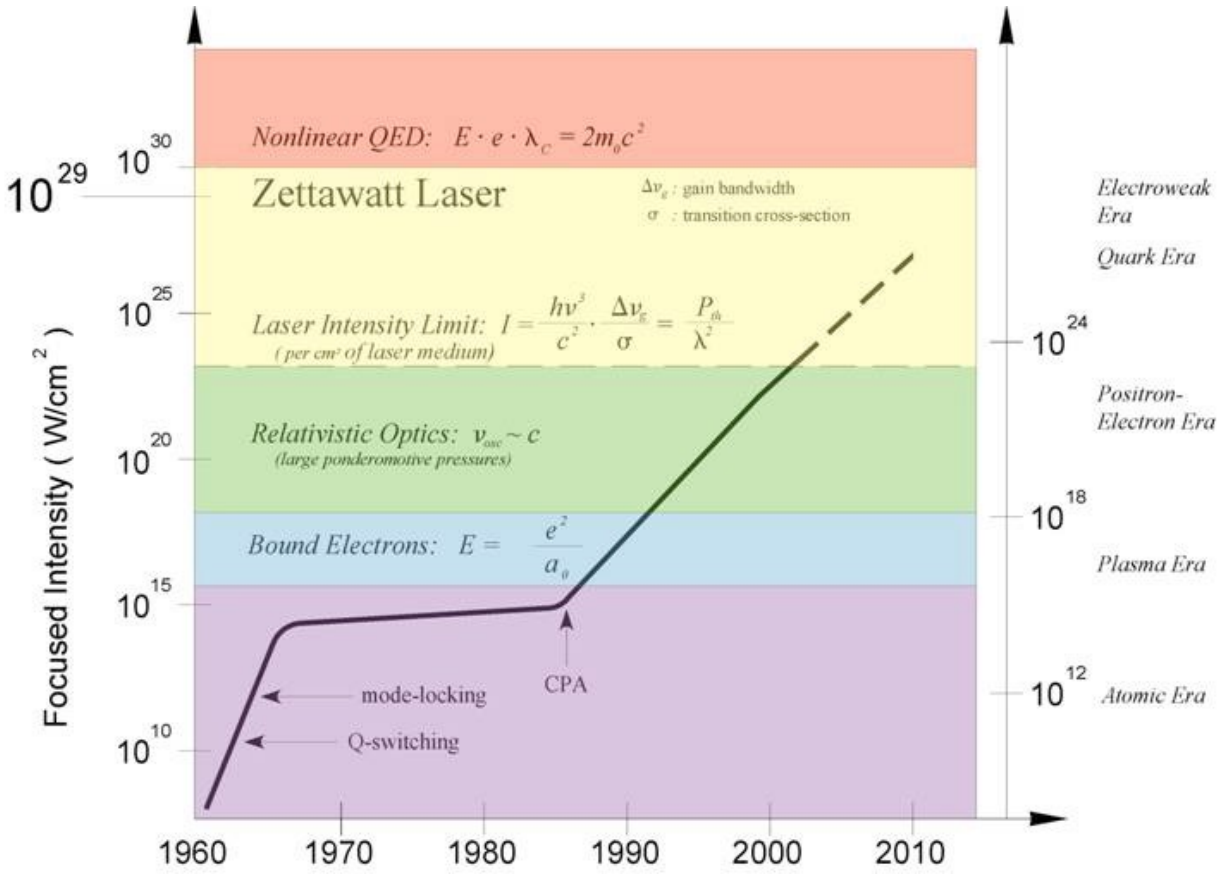


Figure 180. Graph showing history of maximum laser intensities (dictated by technological advancements). The label "CPA" stands for chirped pulse amplification.[503] Credit: courtesy of Wikipedia.

So, what is the best infrastructure for the global delivery of this awesome power? You guessed it, it is fiber optics. As you saw above the French are adapting optical fibers for command and control because they are radiation tolerant. But more importantly, fiber optics is not only heat tolerant it is also a transducer, it converts laser light into electrical power and back into laser signal as video, audio or data. Perhaps the most important reason in favor of the fiber optic infrastructure for the LaserEmpowered world is the upcoming revolution in the power grid. In 2004 the U.S. Federal Communications Commission adopted rule changes that allow utility companies to provide broadband over powerlines, fostering greater competition among high-speed Internet providers. This grand opportunity for power companies will further stimulate the adoption of fiber optics in the energy sector, introducing what I call the quadruple play of services, broadband power, video, audio and data over fiber (Pof).[504]

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"Power utilities are important players behind the scenes of the continent's fiber grids. In fact, electric utilities and municipalities own about 5 to 10% of the fiber deployed in the U.S. and Canada. Almost every large investor-owned or government utility has extensive fiber networks. Even most small utilities with more than 10,000 customers have their own fiber networks. First, power utilities as a group historically have usually been phone companies' biggest or second biggest customers. Second, power utilities are in a unique position to play an important and profitable part in the increasingly important telecommunications revolution."[506] Just like the NIF is generating laser star power (quadrillion watts of energy or Petawatts) at the Laurence Livermore Laboratory, the LaserEmpowered Homeowner can also generate the coherent cosmic power in his home space with a tabletop laser diode.[507] By integrating this Petawatt Tabletop laser with a fiber optic solution offered by JDS Uniphase[508] (considered by Gilder to be the Intel of the Telecosm) the smart home owner can now create the photonic power line home network (PPHN). With the PPHN as the foundational infrastructure for home technology integration or the HTI system, the smart homeowner will be capable of powering and connecting the entire home. See the article: PHOTONIC FRONTIERS: Photonic power delivery: Photonic power conversion delivers power via laser beams.Transmitting power in the form of light eliminates electrical connections, saving money and eliminating noise for equipment in difficult locations.JEFF HECHT, CONTRIBUTING EDITOR @ LaserFocusWorld

Figure 181. Optical fiber composite overhead ground wire (OPGW) is a type of cable that is used in the construction of electric power transmission and distribution lines. Such cable combines the functions of grounding and communications. An OPGW cable contains a tubular structure with one or more optical fibers in it, surrounded by layers of steel and aluminum wire. The OPGW cable is run between the tops of high-voltage electricity pylons. The conductive part of the cable serves to bond adjacent towers to earth ground, and shields the high-voltage conductors from lightning strikes. The optical fibers within the cable can be used for high-speed transmission of data, either for the electrical utility's own purposes of protection and control of the transmission line, for the utility's own voice and data communication, or may be leased or sold to third parties to serve as a high-speed fiber interconnection between cities.[509] Credit: courtesy of fiberplanners.com.

When a Photonic Power Converter (PPC) is packaged with fiber, which connects to a high power laser source, it basically forms a power line, except the "power" is carried by light.[510] According to Wikipedia: In May 2005, JDSU acquired Photonic Power Systems, a provider of photonic power for the delivery of power over fiber. Photonic power is a power delivery system whereby light from a laser source travels over fiber to its destination where it is then is changed to electricity using a photovoltaic power converter. The acquisition provided a solution to remote powering for many commercial applications, including medical, wireless communications, electrical power, industrial sensor, and aerospace applications. Imagine our homes and our automobiles being powered by the purity of the fiber optic laser light![511]What we are now witnessing with the photonic Powerline home network is the emergence of a fiber optic cable that is capable of providing a quadruple play of services (broadband power, video, audio and data). This universal cable structure will unify and simplify the whole infrastructure of the LaserEmpowered Home. Through it the home technology integrator can configure any desired network topology and connect the smart home to the Lambdasphere.

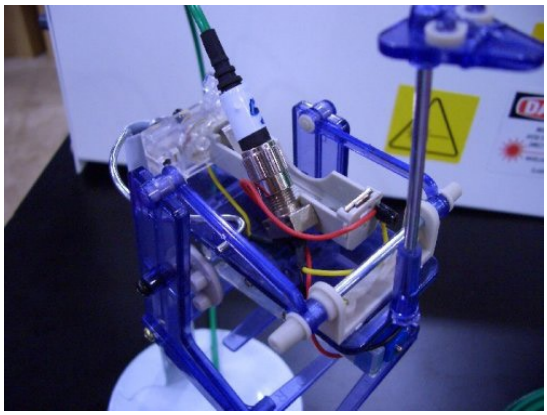


Figure 182. JDSU ran a simple demo of the power-over-fiber technology, which it gained through the acquisition of Photonic Power Systems. Laser light passes through a standard optical fiber (the green cable at the top of this image) onto a tiny solar cell where it is converted into electricity. In the demo unit shown here, the electricity is used to drive a motor. [512] Credit; courtesy of Photonics West.

The coherent power of Laser Fusion and the energetic mission given to NIF will be distributed globally through the Photonic networks of Dense Wave Division Multiplexing as it is described in chapter 10 of the "Future of Optical Networks by Regis J. Bates entitled "Where Is It All Heading? The fiber cables being installed consist of 96 to 192 fibers in a bundle (or many more in the long haul networks, up to 864 in 2001). If we have 192 fibers and can place 1,000 different wavelengths on each fiber, we will have: 192 X 1000 = 192,000 different wavelengths. Extending that number to a lambda carrying OC-192 (Optical Capacity) today at approximately 10 Gbps (Giga bytes per second), the result is: 192,000 X 10 Gbps per 1 = 1,920,000,000,000,000bps or 1.920 Peta bits per second. That is a consolidated figure, but is a significant number. However, the snapshot is using the OC-192 at 10 Gbps for the overall data rate. The newer OC-768 = 4 x 192 operates at 40 Gbps. If we extend that same logic, the results are as follows: 192 fibers X 40 Gbps per (1) X 1,000 1 per fiber = 7.680 Petra bits per second." The Laser energetics of these optical pipe lines will replace all of the world's oil and gas pipe lines, establishing thereby the new laser power infrastructure.

Fiber to the x (FTTX) is a generic term for any network architecture that uses optical fiber to replace all or part of the usual copper local loop used for telecommunications. The four technologies, in order of an increasingly longer fiber loop are:

- Fiber to the node / neighborhood (FTTN) / Fiber to the cabinet (FTTCab)
- Fiber to the curb (FTTC) / Fibre to the kerb (FTTK)[1]
- Fiber to the building (FTTB)
- Fiber to the home (FTTH)

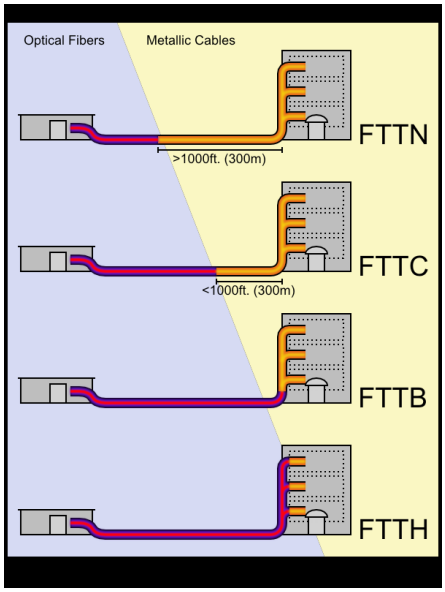


Figure 183. A schematic illustrating how the FTTX architectures vary with regard to the distance between the optical fiber and the end-user. The building on the left is the central office; the building on the right is one of the buildings served by the central office. The dotted rectangles represent separate living or office spaces within the same building. Credit: courtesy of Wikipedia.

In the actual deployments, the difference between FTTN and FTTC is quite subtle and is mostly that the latter is nearer the customer than the former. The poorly-defined term fiber to the premises (FTTP) is sometimes used to describe FTTH and/or FTTB. FiOS (Fiber Optic Service) is a fiber to the premises (FTTP) telecommunications service, presently offered in some areas of the United States by Verizon. Verizon has cited the fact that "fios" is an Irish word for "knowledge",[1][2] and has stated in mailings to New Jersey customers that it stands for "Fiber-Optic Service". Verizon has attracted consumer and media attention in the area of broadband Internet access as the first major U.S. carrier to offer such a service. In their rapidly expanding coverage areas, FiOS provides telephone, Internet and digital video services to the subscriber's premises. Some areas do not have service due to franchise agreements, and some can only receive the internet access, also due to franchising. Verizon FiOS products are delivered over the FTTP network using passive optical network (PON) technology. Voice, video, and data travel over three wavelengths in the infrared spectrum. To serve a home, a single-mode optical fiber extends from an optical line terminal (OLT) at a FiOS central office or head end out to the neighborhoods where an optical splitter fans out the same signal on up to 32 fibers- thus serving up to 32 subscribers. At the subscriber's home, an optical network terminal (ONT) transfers data onto the corresponding copper wiring for phone, video and Internet access.[7]

I realized by practicing LaserEmpowered image streaming—a visualization exercise found in the book, The Einstein Factor,[513] by Dr. Win Wenger—how the Lambdasphere (rainbow lasers on the optical internet) emerged. This image became clearer for me when I saw that the optical Internet was generated from a confluence of laser light wave division multiplexing (WDM). "In fiber-optic communications, wavelength-division multiplexing (WDM) is a technology which multiplexes multiple optical carrier signals on a single optical fiber by using different wavelengths (colours) of laser light to carry different signals. This allows for a multiplication in capacity, in addition to enabling bidirectional communications over one strand of fiber. "This is a form of frequency division multiplexing (FDM) but is commonly called wavelength division multiplexing."[1] The term wavelength-division multiplexing is commonly applied to an optical carrier (which is typically described by its wavelength), whereas frequency-division multiplexing typically applies to a radio carrier (which is more often described by frequency). However, since wavelength and frequency are inversely proportional, and since radio and light are both forms of electromagnetic radiation, the two terms are equivalent."[514]

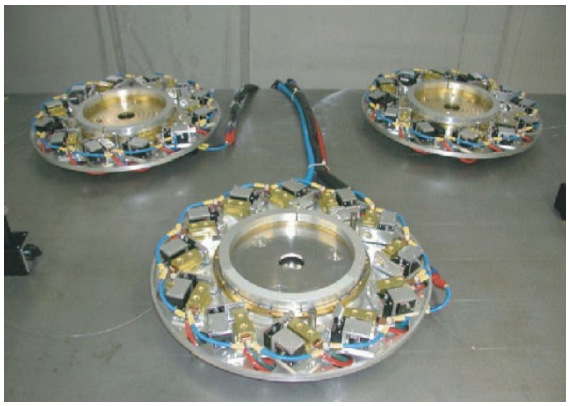


Figure 184. A fiber disk laser is a fiber laser with transverse delivery of the pump light. They are characterized by the pump beam not being parallel to the active core of the optical fiber (as in a double-clad fiber), but directed to the coil of the fiber at an angle (usually, between 10 and 40 degrees). This allows use of the specific shape of the pump beam emitted by the laser diode, providing the efficient use of the pump. Fiber disk lasers are used for cutting of metal (up to few mm thick), welding and folding. The disk-shaped configuration allows efficient heat dissipation (usually, the disks are cooled with flowing water)); allowing power scaling. Power scaling of a laser is increasing its output power without changing the geometry, shape, or principle of operation. Power scalability is considered an important advantage in a laser design. Usually, power scaling requires a more powerful pump source, stronger cooling, and an increase in size. It may also require reduction of the background loss in the laser resonator and, in particular, in the gain medium.[515] Credit: courtesy of Wikipedia.

Einstein's LaserEmpowered Vision in the 21st century is finally coming to every home on the planet thanks to the continuum of the New Lambdasphere entitled Fiber to the Home (FTTH) and Fiber in the Home (FITH) with the photonics power line home network. Through this fiber optic life extension, the laser intelligence of the global network will now be installed in every home. Just as electricity illuminates every home, laser light will convert every household into a smart home. The coherent cosmic light will empower the homeowner to take full command not only of all the systems (power, water, heater, computer network, the radio, TV spectrum and security) and appliances in the house; it will immerse him or her in the visual education mode. Through this mode the Einsteinian visual thinker will emerge as the prototype of a new visual knowledge society, a post-literate society that will liberate humanity from the cognitive entrapment of a verbal culture run amuck. The ultimate product of this emergent visual culture will be the establishment of the Einsteinian model of the visual thinker who will produce in turn a higher quality human being that will take full responsibility for and steer our planet towards greater accomplishments in health, wealth and wisdom.

> The broadband capability of the fiber optic cable will bring the visual education process to every room in your home because of the interactive nature of the new displays (rear projection laser TV, plasma TV, high definition TV). These displays will no longer serve only as passive entertainment devices but will be interactive windows through which we will participate in the new Lambdasphere. The visual organ of knowledge will be fully activated and directed to the fruition of all human endeavors. Through these life-size displays we will live in an

augmented reality that will enable us to see in real time what the Hubble telescope sees in the macroscopic universe as well as what the most powerful microscopes are seeing at nanoscales. We will remotely interact with and see each other as if we were there because we are there; time and space have now been conquered. The integration of the television and the telephone on the internet (IPTV and VoIP), now called the triple play (video, audio and data) enables us to fully develop our experience of the coherent world with telepresence. This universal extension of our presence on the Lambdasphere gives us a new awareness of our being. Telepresence enables everyone to participate in the mission of injecting and programming the universe with our laser intelligence.,

Figure 185. Racks of telecommunications equipment in part of a data center. Structured Cabling is defined as building or campus telecommunications cabling infrastructure that consists of a number of standardized smaller elements (hence structured) called subsystems.[516] Credit: courtesy of Wikipedia.

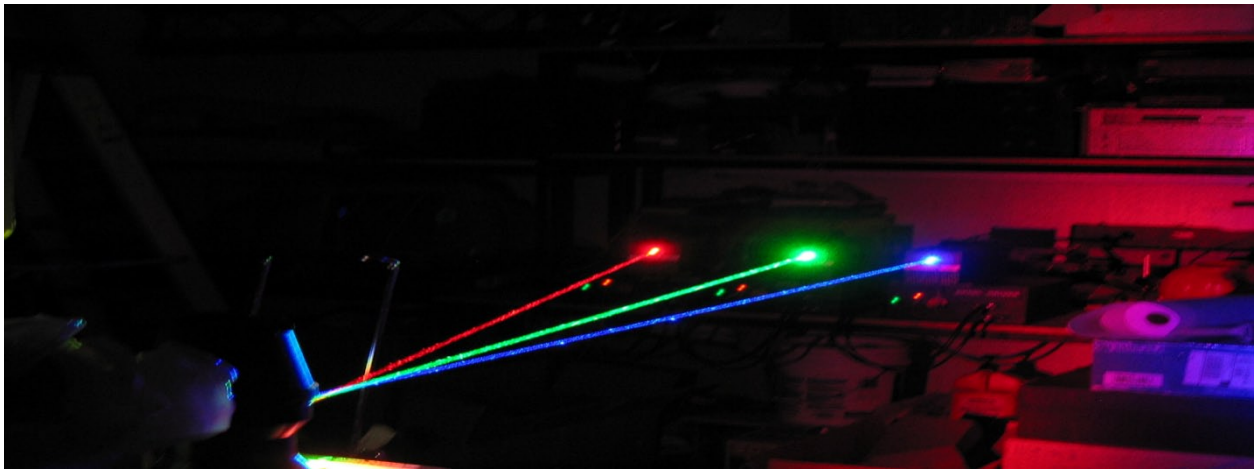


Figure 186. http://www.metatronvision.com/ZTV.html. Credit: courtesy of Metatronvision.com

Just as the brain serves as the central command center for all our bodily functions so will the Microvsion VRD serve as the central command center for our LaserEmpowered Homes. In 2005, "Microvision announced that it filed for patent protection relating to a novel display system architecture that would use an array of low-cost Lasers to enable very high resolution displays with extremely wide fields of view. Field of view is the term used to describe the apparent size of the virtual image created by a near-eye display. According to Microvision, consumer electronics companies are interested in wearable displays that can simulate the "immersive" viewing experience of a movie theater or a very large - 80 to 100 inch - high resolution television. Such systems have to be both practical in size and affordable in order to appeal to the mass market… Consumer electronics companies are interested in wearable display systems for portable media of all kinds. Such systems could be used to watch films, access the Internet, or play computer games in 2D or 3D with the immersive feeling of a big-screen cinema or a really large television."[517] This is the advent of the full color VRD (Spectrum) version that I recommend.

> "Microvision's IPM (integrated photonics module) display platform is unique in many respects. It is expected to yield the ultimate solution -- a large image in a small package," said Alexander Tokman, Microvision CEO. "Unlike most matrix-display technologies, such as a LCD or DLP, we modulate laser light temporally and spatially using a single tiny vibrating silicon mirror to produce an image. The inherent advantages of this display platform include spectacular image quality, small form factor and low power.

For example, because PicoP (miniature projection display) is using a collimated beam of laser light to produce a full-color, high resolution and contrast image it exhibits an "infinite" depth of focus. As a result, this product will not require a projection lens which further reduces its form factor and cost. The overall package can be very compact and driven by low power. A small form factor balanced with low power requirements is essential to portable handset manufacturers to enable personal projection applications.

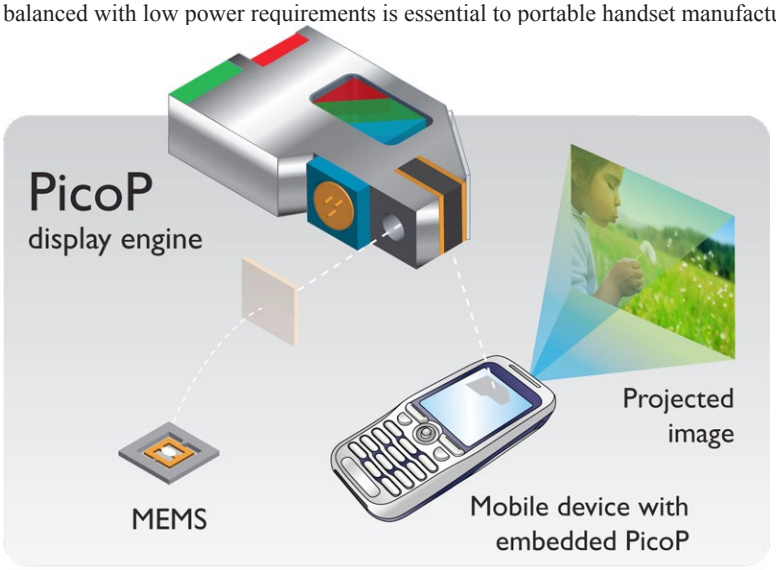


Figure 187. Mobile devices such as cell phones, portable media players, digital cameras, and laptops can be enabled with pico projection capabilities turning photos, videos, and other content into big viewing experiences that can be shared with others. Embedded pico projectors leverage Microvision's PicoP display engine which at its heart, contains Microvision's patented MEMS scanner. Other technology components include, laser light sources, optics, and electronics. These components are brought to life using Microvision's proprietary software and expertise.

The wireless Microvision display and its wearable computer can now be coupled to the fiber optic broadband wiring known as Fiber Distributed Data Interfaces or FDDI, creating a laser extension for our central and autonomous nervous system in our homes. With this laser and fiber based configuration a high order structural organization of the home emerges. The coherent and connected structure of lasers in ultra pure glass crystal will now inform our homes with the idea of Home Technology Integration (HTI). This idea of programming, connecting and automating all the major components (computer network, power, light, water, Heating Ventilation Air Conditioning or HVAC, security and entertainment) of a home is the natural-techno evolutionary result of the universal penetration of our laser intelligence. Through it we can we can coordinate all the activities within our homes and infuse it with our laser intelligence.

Figure 188."Microvision's IPM display platform is expected to support a variety of large market opportunities in addition to personal projection displays, including wearable displays for military, industrial, and consumer applications as well as automotive head-up displays," concluded Tokman.

A comprehensive starter curriculum for Home Technology Integrators was developed by the Internet Home Alliance.[518] The intellectual capital resources that are now being invested to develop the smart home space are truly staggering. It is now high times for the smart home owner. Verizon alone invested 22 billion in its Fiber Optics to the Home (FTTH) project called FiOS. And now structured wiring companies are "future proofing" homes with Fiber Optics in the Home (FITH). How this new infrastructure

is connected to the New Lambdasphere and what it means for the family is essentially what this whole book is about. The laser Intelligence of Kids will fully actualize because of the resonance embedded in the infrastructure of our being. Baby Einstein's will no longer be a wish or chimera but a reality, thanks to the Imagineering laboratory of the internet. Universal access to human knowledge through global libraries,[519] schools and the universe at large will free us from all monopolistic educational traditions.

"The main benefits of HTI—according to Quentin Wells—are simple: it makes the user's life more convenient, safer, and more fun. It provides maximum use and enjoyment of electronic media, internet, and telecommunication systems. HTI makes technology available where and when the user wants it. Automated systems that function on demand or by programmed direction to meet predetermined needs in a timely manner often become essential services rather than mere conveniences. Similarly, HTI's ability to make communication and data sharing easy to use throughout a home enables users to make maximum use of technology to save time while accomplishing more. When that increased productivity is utilized in a home business setting, the payoff occurs not only in time efficiency, but in increased profitability. When technology extends the senses and physical abilities of the physically challenged, while at the same time monitoring their safety and health, it becomes a critical, life-enhancing, if not life-saving necessity." [520] "The key to home automation, or home technology integration, is making diverse subsystems work together seamlessly… The infrastructure can be classified under one of these six categories: structured wiring, structured media center (SMC), control processor, user interface, home portal, or residential gateway… Many homeowners who are comfortable with the Web are eager to control their home systems through their personal computer's Web browser (Home portal Figure 183). Integrated home automation systems can provide a Web browser interface through the use of a residential portal, which takes the command structures of the automation systems and translates them into control codes that can be understood by a browser. To set up the home portal for your customers, you need to install a Web browser and portal software on their PC. The Figure shows an example of a simple home portal with icons."[521]Through this home portal on the Microvision display the home owner will have complete access and control of all the subsystems on the photonic powerline home network.

Figure 189. Home Portal.

It is now very clear that Microvision technology and the Open CourseWare Consortia applied to HTI has emerged as a powerful platform for the realization of Einstein's LaserEmpowered Vision. Now visual education through this platform will help us unlock the knowledge assets that reside inside the brain of a laser informed homeowner. And through it the visually informed homeowner will liberate his imagination. This new found competence will in turn develop a scientific visual culture and establish it as our primary source of intelligence and wisdom. In essence what the HTI system enables is a new visual culture that empowers the homeowner to take full command of his personal space. Through HTI, the homeowner appropriates the creative powers of the Visual Programmer. Thanks to this competence we are now able to inject our laser-spatial or visual intelligence directly into our home space. The visual culture that is emerging is also creating a new generation of creative talent that will re-create our entertainment and business world. Business Week (a weekly business journal owned by the McGraw Hill Publishers) said there are a million Spielgsburgs in production right now thanks to the personal video studio that was made possible by the video cam corder, professional video editing software and the internet. The video game industry will increasingly play a very important role in the visual education format once a great number of educators realize the great value of this medium. When video conferencing and teleclasses become as real as our classrooms and the universal visual language of lasers becomes formally available to all and a global standard in visual education is established all the capitalistic monopolies will finally fall.

Part 3. The VRD as a Laser Transducer of the Vector Potential into the Action potential of the Brain produces Laser Cognition Correction within the Bose-Einstein Structure of perception.

Part 3.8 Visual Language of Lasers emerges from Einstein's Visual Thought

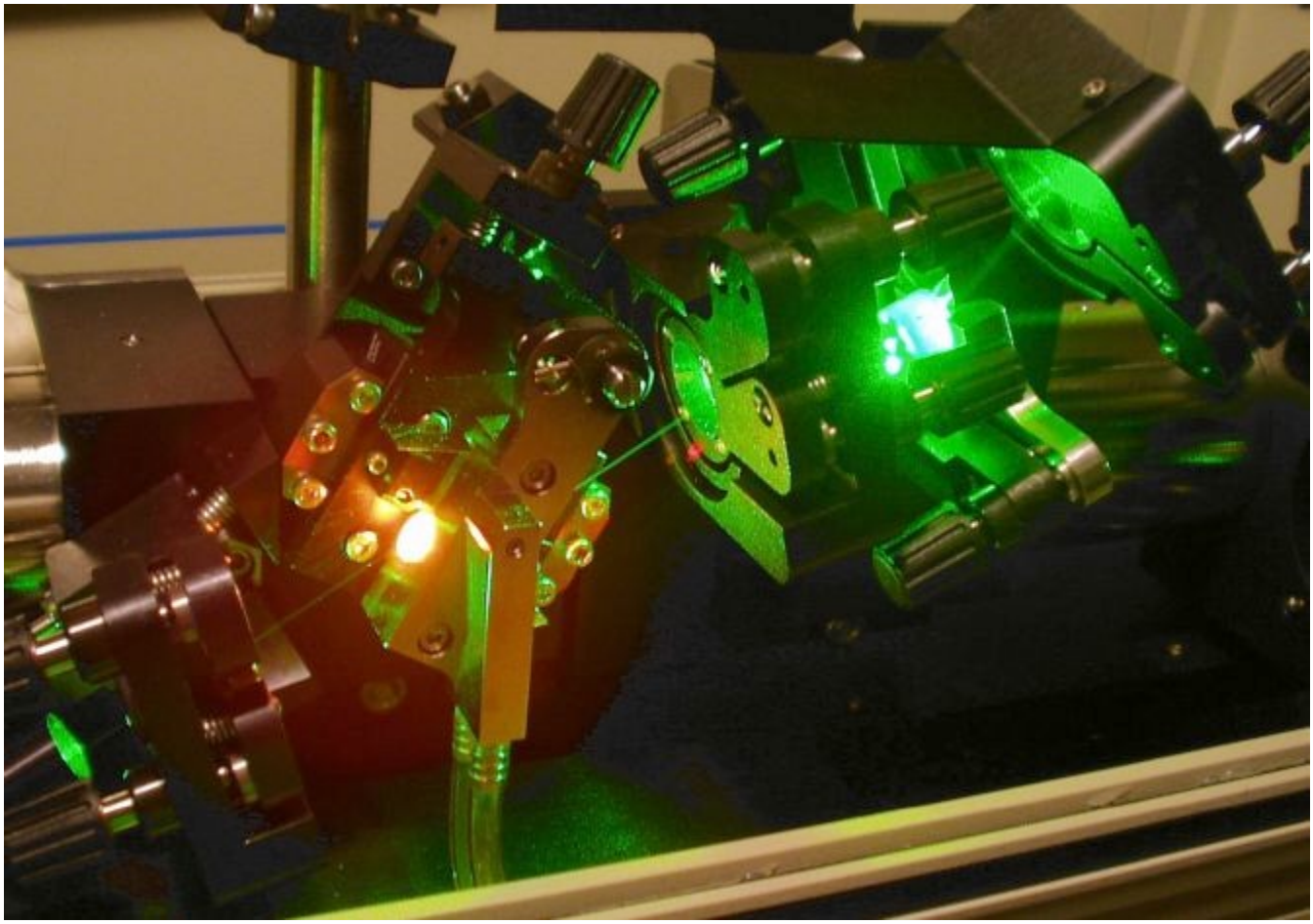


Figure 190. Ti:sapphire lasers (also known as Ti:Al2O3 lasers, titanium-sapphire lasers, or simply Ti:sapphs) are tunable lasers which emit red and near-infrared light in the range from 650 to 1100 nanometers. These lasers are mainly used in scientific research because of their tunability and their ability to generate ultrashort pulses. Courtesy of Wikipedia[522]

The laser informed idea for this book is the fruit of a convergence of multiple conceptual spaces (philosophy, law, science, history, art, economics, education, info-technology and the politics of geothermal and laser fusion energy).[523] Einstein formulated the conceptual foundation of the laser in his Collected Papers. My laser informed vision emerged from his vision, reason and imagination and thanks to the intellectual freedom to inquire and create (libertarian socialism) that is available over the internet. The recognition of the Laser Information Age resulted from this global exposure to the web of knowledge that the internet provided. Noam Chomsky's bio-linguistics illuminated my conception of language, knowledge and politics. For Chomsky and the rational philosophical tradition (Plato, Leibniz, Descartes etc) that he clarifies and updates, language and knowledge are biologically embedded or innate within the cognitive areas of the brain. Language like vision is not learned but a faculty of the brain that is to be properly cultivated. Mathematics as the language of science itself is a fruit of this cognitive structure. For example, the discrete infinite of the number system is really an abstraction of the auditory system, resulting from the discrete infinite combinatorial structure of letters or sounds of the alphabet.[524] Geometry is an abstraction or extension of the visual system. Einstein's geometry of the space-time continuum (the special and general theory of Relativity) is really the fruit of his visual thinking faculty.[525]

In his seminal lectures on: Science in the Twentieth Century: A Social-Intellectual Survey, Professor Steven L. Goldman stated that "how we know determines what we know." This statement addresses the foundational cognitive issue that goes to the core of the Laser Informed Vision of education in the 21st century. Our mission is to provide visual, auditory and kinesthetic knowledge about how we know what we know with lasers and promote the search for truth and reality. I believe that through the Laser Informed

Vision platform, society will be able to liberate itself from the capitalized propaganda machine of the current multi-media that filters the essential knowledge required for humanity's survival and success. I agree with Prof. Goldman when he emphatically stated that, "Chomsky is to linguistics what Einstein is to physics," and what Peter Drucker is to Knowledge Management. [526] My Laser Informed Vision of the unity of scientific knowledge found a clear reflection in the masterful work of Edward O. Wilson (Consilence: the unity of knowledge).[527] In this work the author established how the scientist of the enlightenment unlocked the cognitive code of the electromagnetic spectrum, enabling humanity to liberate itself from the cognitive prison of superstitious ignorance, poverty and deception, paving the road to a true knowledge of the universe for health, wealth and wisdom via the Open Resource Based Economy (ORBE). Today we are still struggling against superstition and the feudal industrial model of wage slavery promoted by the corporations.[528]

Arthur Koestler, in The Act of Creation, states "the thesis that 'creative originality' does not mean creating a system of ideas out of nothing but rather out of the combination of well-established patterns of thought—by a process of cross-fertilization."[529] This cross-fertilization of the most successful patterns of thoughts on our planet is illustrated here through the great historical interaction between the currents of laser science inherited by the Laser industry and virtual retina display on one side. And the visual cognition software system established by the Open software platform and its educational extension via the MIT Open Courseware Consortia, and UNESCO's Virtual University on the other. The combination of MITVU/VRD programs applied to geothermal or laser fusion power is truly a unique path to the realization of the ORBE. The photonics powerline cable of the fiber optic industry (power, video, audio and data over fiber) is emerging as the new global nervous system. This cross-fertilization has been so successful that now everyone on the planet can participate fully in the fruits of the internal coherence of scientific knowledge that is health, wealth and wisdom. And thereby protect humanity from the external incoherence that corrupts it (the Federal Reserve System).

It is often said that the word is mightier than the sword, but we can now see that visual ideas are just as powerful as words and swords. This expression is the result of the critical distinction between visual thinking or pictorial knowing, verbal thinking or literal knowing and bodily kinesthetic intelligent action or doing. Human thought and its intelligence develops and expresses itself mostly through the oral, written and visual language that is transduced (converted) into electrical signals in the neurons of the brain. These neurons are cells that use a language of electrical impulses to communicate messages from the brain to the rest of the body. The computational neuroscience of this electrical language is so successful that computer chips (Cyberkinetics Neurotechnology Systems) can now execute commands on a display directly from a user's thoughts.[530] And vice versa the VRD is able to re-create a computer image directly in the visual cortex. (See the MIT Media Lab Synthetic Neurobiology Group).

According to Wikipedia; a brain-computer interface (BCI), sometimes called a direct neural interface or a brain-machine interface, is a direct communication pathway between a brain and an external device. BCIs were aimed at assisting, augmenting or repairing human cognitive or sensory-motor functions. Research on BCIs began in the 1970s at the University of California Los Angeles (UCLA) under a grant from the National Science Foundation followed by a contract from DARPA. [1][2]. These papers also mark the first appearance of the expression "Brain Computer Interface" in the scientific literature. The field has since blossomed spectacularly, mostly toward neuroprosthetics applications that aim at restoring damaged hearing, sight and movement. Thanks to the remarkable cortical plasticity of the brain, signals from implanted prostheses can, after adaptation, be handled by the brain like natural sensor or effector channels.[3] Following years of animal experimentation, the first neuroprosthetic devices implanted in humans appeared in the mid-nineties… In vision science, direct brain implants have been used to treat non-congenital (acquired) blindness. One of the first scientists to come up with a working brain interface to restore sight was private researcher William Dobelle. Dobelle's first prototype was implanted into "Jerry," a man blinded in adulthood, in 1978. A single-array BCI containing 68 electrodes was implanted onto Jerry's visual cortex and succeeded in producing phosphenes, the sensation of seeing light. The system included cameras mounted on glasses to send signals to the implant. Initially, the implant allowed Jerry to see shades of grey in a limited field of vision at a low frame-rate. This also required him to be hooked up to a two-ton mainframe, but shrinking electronics and faster computers made his artificial eye more portable and now enable him to perform simple tasks unassisted.[20]

Figure 191. Dummy unit illustrating the design of a BrainGate interface. Photo Courtesy of Wikipedia

In 2002, Jens Naumann, also blinded in adulthood, became the first in a series of 16 paying patients to receive Dobelle's second generation implant, marking one of the earliest commercial uses of BCIs. The second generation device used a more sophisticated implant enabling better mapping of phosphenes into coherent vision. Phosphenes are spread out across the visual field in what researchers call the starry-night effect. Immediately after his implant, Jens was able to use his imperfectly restored vision to drive slowly around the parking area of the research institute. BCIs focusing on motor neuroprosthetics aim to either restore movement in individuals with paralysis or provide devices to assist them, such as interfaces with computers or robot arms. Researchers at Emory University in Atlanta led by Philip Kennedy and Roy Bakay were first to install a brain implant in a human that produced signals of high enough quality to simulate movement. Their patient, Johnny Ray, suffered from 'locked-in syndrome' after suffering a brain-stem stroke. Ray's implant was installed in 1998 and he lived long enough to start working with the implant, eventually learning to control a computer cursor.[21]]Tetraplegic Matt Nagle became the first person to control an artificial hand using a BCI in 2005 as part of the first nine-month human trial of Cyberkinetics Neurotechnology's BrainGate chip-implant. Implanted in Nagle's right precentral gyrus (area of the motor cortex for arm movement), the 96-electrode BrainGate implant allowed Nagle to control a robotic arm by thinking about moving his hand as well as a computer cursor, lights and TV.[22]

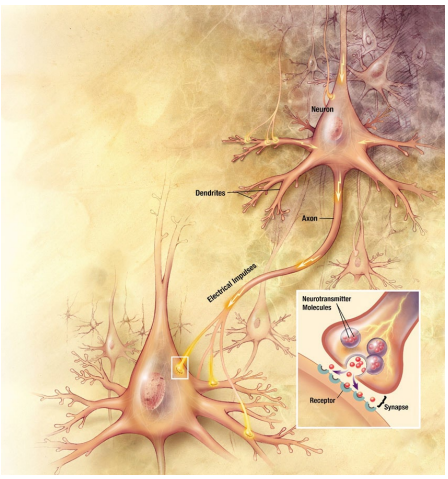


Figure 192. Neurons (also known as nerve cells) are electrically excitable cells in the nervous system that process and transmit information. Neurons are the core components of the brain, and spinal cord in vertebrates and ventral nerve cord in invertebrates, and peripheral nerves… A signal propagating down an axon to the cell body and dendrites of the next cell. The cell membrane in the axon and soma contain voltage-gated ion channels which allow the neuron to generate and propagate an electrical impulse (an action potential). Credit: courtesy of Wikipedia.[531]

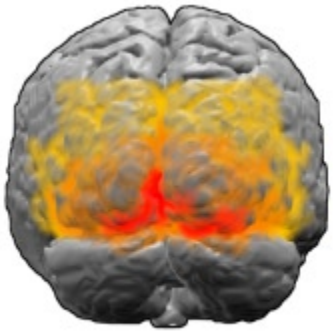


Figure 193. The term visual cortex refers to the primary visual cortex (also known as striate cortex or V1) and extrastriate visual cortical areas such as V2, V3, V4, and V5. The primary visual cortex is anatomically equivalent to Brodmann area 17, or BA17. [532] Credit: courtesy of Wikipedia.

"Computational neuroscience is an interdisciplinary science that links the diverse fields of neuroscience, cognitive science, electrical engineering, computer science, physics and mathematics. Historically, the term was introduced by Eric L. Schwartz, who organized a conference, held in 1985 in Carmel, California at the request of the Systems Development Foundation, to provide a summary of the current status of a field which until that point was referred to by a variety of names, such as neural modeling, brain theory and neural networks. The proceedings of this definitional meeting were later published as the book "Computational Neuroscience ", MIT Press (1990). The early historical roots of the field can be traced to the work of people such as Hodgkin & Huxley, Hubel & Wiesel, and David Marr, to name but a few. Hodgkin & Huxley developed the voltage clamp and created the first mathematical model of the action potential. Hubel & Wiesel discovered that neurons in primary visual cortex, the first cortical area to process information coming from the retina, have oriented receptive fields and are organized in columns (Hubel & Wiesel, 1962). David Marr's work focused on the interactions between neurons, suggesting computational approaches to the study of how functional groups of neurons within the hippocampus and neocortex interact, store, process, and transmit information. Computational modeling of biophysically realistic neurons and dendrites began with the work of Wilfrid Rall, with the first multicompartmental model using cable theory."[533]

See the MIT OCW Brain and Cognitive Sciences Course: Introduction to Computational Neuroscience: "The central assumption of computational neuroscience is that the brain computes. What does that mean? Generally speaking, a computer is a dynamical system whose state variables encode information about the external world. In short, computation equals coding plus dynamics. Some neuroscientists study the way that information is encoded in neural activity and other dynamical variables of the brain. Others try to characterize how these dynamical variables evolve with time. The study of neural dynamics can be further subdivided into two separate strands. One tradition, exemplified by the work of Hodgkin and Huxley, focuses on the biophysics of single neurons. The other focuses on the dynamics of networks, concerning itself with phenomena that emerge from the interactions between neurons. Therefore computational neuroscience can be divided into three subspecialties: neural coding, biophysics of neurons, and neural networks." [534]

It was precisely with Steven Pinker's excellent popularization of Chomskean linguistics in: The language Instinct, How The Mind Creates Language, that I realized the difference between visual thoughts and words. For me, this distinction produced a profound sense of freedom from the verbal culture. This realization also gave me a new insight about the visual sense in general and Einstein's laser intelligence in particular. The following paragraph by Dr. Pinker was a powerful turning point in my visual education. "Physical scientists are even more adamant that their thinking is geometrical, not verbal. Michael Faraday, the originator of our modern conception of electrical and magnetic fields, had no training in mathematics but arrived at his insights by visualizing lines of force as narrow tubes curving through space. James Clark Maxwell formalized the concepts of electromagnetic fields in a set of mathematical equations and is considered the prime example of an abstract theoretician, but he set down the equations only after mentally playing with elaborate imaginary models of sheets and fluids. Nikola Tesla's idea for the electrical motor and generator, Friedrich Kekule's discovery of the benzene ring that kicked off modern organic chemistry, Ernest Lawrence's conception of the cyclotron, James Watson and Frances Crick's discovery of the DNA double helix—all came to them in images. The most famous self-described visual thinker is Albert Einstein, who arrived at some of his insights by imagining himself riding a beam of light and looking back at a clock, or dropping a coin while standing in a plummeting elevator."[535] According to Dr Pinker it is with Alan Turing,[536] the legendary father of the computational theory—from whom the electronic computer derived its current architecture—that visual thinking became scientifically understandable and reproducible. It is more precisely with the advent of supercomputing that the power of visualization in science has come to the foreground.

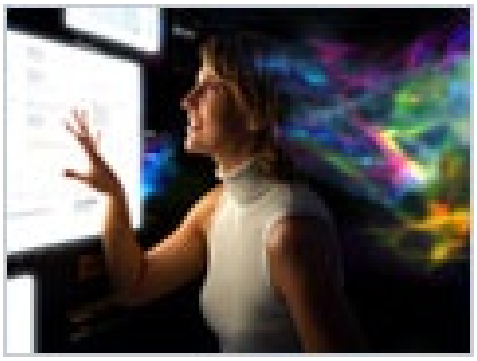


Figure 194. Creating cyberenvironments to simplify science. In collaboration with scientists and engineers, the National Center for Supercomputing Applications (NCSA) creates secure, easy-to-use interfaces to instruments, data, high-performance computing systems, and analysis, visualization and collaboration tools. Whether they're astronomers or earthquake engineers, people use these cyberenvironments to get a systemic view of their discipline, to manage complex projects, and to automate and combine processes @ http://www.ncsa.uiuc.edu/AboutUs/. Credit: courtesy of NCSA.

According to NCSA "computational modeling and simulation produce a flood of data that researchers must parse in search of new knowledge. The team from the University of Illinois' National Center for Supercomputing Applications (NCSA) Advanced Visualization Laboratory (AVL) aids in this process by transforming dry data into artful animations that can help pinpoint the moment when a thunderstorm gives birth to a tornado or the gases of the early galaxy coalesce into planets."[537] This visual-computational or representational theory of the mind is one of the 4 major approaches to the foundation of our current cognitive science. According to Peter Gardenfors; "Within cognitive science, two approaches currently dominate the problem of modeling representations. The symbolic approach views cognition as computation involving symbolic manipulation. Connectionism, a special case of associationism, models associations using artificial neuron networks. Peter Gardenfors (The Geometry of Thought) offers his theory of conceptual representations as a bridge between the symbolic and connectionist approaches. Symbolic representation is particularly weak at modeling concept learning, which is paramount for understanding many cognitive phenomena. Concept learning is closely tied to the notion of similarity, which is also poorly served by the connectionist approach. Gardenfors' theory of conceptual spaces presents a framework for representing information on the conceptual level. A conceptual space is built up from geometrical structures based on a number of quality dimensions. Gardenfors also shows how conceptual spaces can serve as an explanatory framework for a number of empirical theories, in particular those concerning concept formation, induction, and semantics. His aim is to present a coherent research program that can be used as a basis for more detailed investigations"[538]

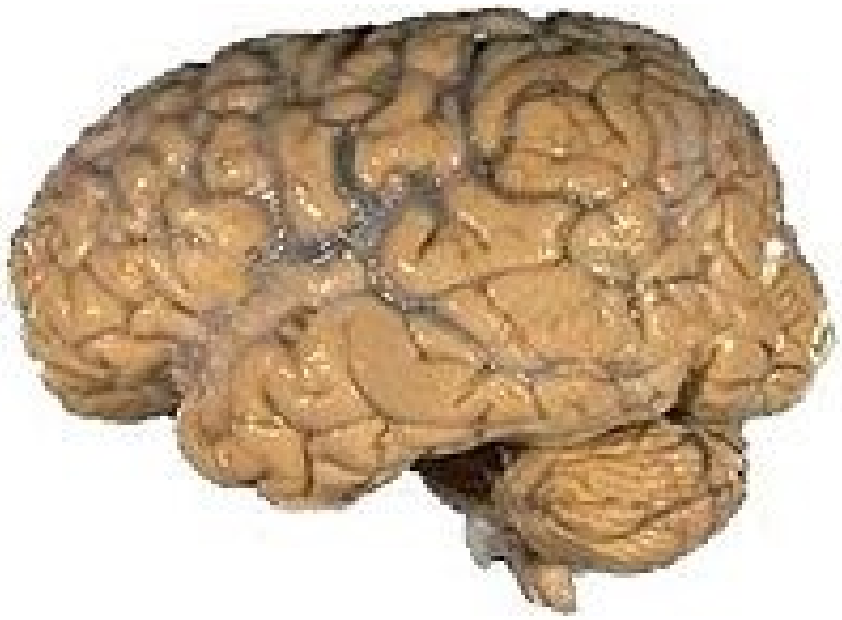


Figure 195. Karl Pribram and colleagues have presented evidence which indicates that memories do not in general appear to be localized in specific regions of brains. Credit: courtesy of Wikipedia.[539]

A fourth approach to the computational neuroscience of cognition that is perhaps more crucial and relevant to the future of the Laser Informed Learner is the application of holography to the biophysical face of information. "The holonomic brain theory, originated by psychologist Karl Pribram and initially developed in collaboration with physicist David Bohm, is a model for human cognition that is drastically different from conventionally accepted ideas: Pribram and Bohm posit a model of cognitive function as being guided by a matrix of neurological wave interference patterns situated temporally between holographic Gestalt perception and discrete, affective, quantum vectors derived from reward anticipation potentials. Pribram was originally struck by the similarity of the hologram idea and Bohm's idea of the implicate order in physics, and contacted him for collaboration. In particular, the fact that information about an image point is distributed throughout the hologram, such that each piece of the hologram contains some information about the entire image, seemed suggestive to Pribram about how the brain could encode memories. (Pribram, 1987). Pribram was encouraged in this line of speculation by the fact that DeValois and DeValois (1980) had found that "the spatial frequency encoding displayed by cells of the visual cortex was best described as a Fourier transform of the input pattern." (Pribram, 1987) This holographic idea lead to the coining of the term "holonomic" to describe the idea in wider contexts than just holograms."[540]

Over and above the differences between these four approaches to our cognitive faculty there is scientific consensus on the methodological high ground that Chomsky has introduced with his successful Galilean approach to the cognitive sciences and their unification with the natural sciences. Even though Chomsky has a slightly distinct view from Pinker he nevertheless acknowledges the visual think mode. "The analysis of linguistic structures could help in understanding other intellectual structures. Now, I don't think there is any scientific evidence about the question of whether we think only in language or not. But introspection indicates pretty clearly that we don't think in language necessarily. We also think in visual images, we think in terms of situations and events, and so on, and many times we can't even express in words what the content of our thinking is. And even if we are able to express it in words, it is a common experience to say something and then to recognize that it is not what we meant, that it is something else."[541]

The language of words according to Noam Chomsky is established by the rules and representations of verbal thinking created by the Mind via a universal grammar embedded in the genetically determined core of our cognitive brain. These ideas were established in: Syntactic Structures the name of an influential book by Noam Chomsky first published in 1957. Widely regarded as one of the most important texts in the field of linguistics,[1] this work laid the foundation of Chomsky's idea of transformational grammar. The book contains the well-known example of a sentence that is completely grammatical, yet completely nonsensical in "Colorless green ideas sleep furiously."[2]The publishing of Syntactic Structures is believed by many academics to be a watershed moment in the annals of modern linguistics. In a review of the book, linguist Robert Lees wrote that the book is 'One of the first serious attempts on the part of a linguist to construct within the tradition of theory-construction a comprehensive theory of language which may be understood in the same sense that a chemical, biological theory is ordinarily understood by experts in those fields. It's not a mere reorganization of the data into a new kind of library catalog, nor another speculative philosophy about the nature of Man and Language, but a rather rigorous explanation of our intuitions about language in terms of an overt axiom system, the theorems derivable from it, explicit results which may be compared with new data and other intuitions, all based plainly on an overt theory of the internal structure of languages.[3]542

This structure of language comes to us via the auditory cortex (ear-brain nerve relation) and its phonology; it is a digital or infinitely discrete combinatorial structure.[543] These ideas were established in: The Sound Pattern of English (frequently referred to as SPE) a work on phonology (a branch of linguistics) by Noam Chomsky and Morris Halle. It presents a comprehensive view of the phonology of English, and stands as a landmark both in the field of phonology and in the analysis of the English language. Chomsky

and Halle present a view of phonology as a linguistic subsystem, separate from other components of the grammar, that transforms an underlying phonemic sequence according to rules and produces as its output the phonetic form that is uttered by a speaker. The theory fits with the rest of Chomsky's early theories of language in the sense that it is transformational; as such it serves as a landmark in Chomsky's theories by adding a clearly articulated theory of phonology to his previous work which focused on syntax.[544]

A wonderful extension of the Chomskean syntax to our visual sense is illustrated in: Visual Syntactic Structures • Towards a Generative Grammar of Visual Language By Neil Cohn @ http://www.emaki.net/.[545] In contrast to the laws of sound patterns coming through the auditory cortex, the visual language is established by the laws of light in the eye-brain nerve relation of the visual cortex; it is a continuous or analog structure. More precisely, the visual system is an optical-electro-chemical field of information, knowledge, memory and imagination.[546] It is now widely recognized that Einstein was a visual thinker, a person who thinks in pictures. But it is less known that the visual language of lasers he conceived is now uniquely poised to be the universal character of intelligence, coherent thought or foundation of the Laser Information Age. Einstein's visual language expressed itself through his creative imagination, which was grounded in a tradition of powerful visual thinkers like Galileo, Faraday, Maxwell, Poincare, among others, and their ideas about light.

Yes, Einstein conquered the calculus—invented by Newton and Leibniz in the 17th century—between the ages of twelve and sixteen. But to him, imagination was more important than knowledge of mathematics or other verbal sources of thought. Visual thought gave him the distinct advantage of placing abstract thoughts or theories within a physical context. He often said that "Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution."[547] It was precisely at the tender age of sixteen in 1895 that he imagined himself riding a bicycle at the speed of light (670 million miles per hour or 186,000 miles per second). In that flight of imagination, he overturned Newton's conception of an absolute time and space and discovered the invariance of light. In his Autobiographical Notes written at sixty-seven years of age, Einstein connected his search for a "universal formal principle" of the true laws of physics with his theory of relativity and traces its roots to that visual thought experiment at sixteen. "How, then, could such a universal principle be found? After ten years of reflection such a principle resulted from a paradox upon which I had already hit at the age of sixteen: If I pursue a beam of light with velocity c (velocity of light in a vacuum), I should observe such a beam of light as a spatially oscillatory electromagnetic field at rest." [548]

And so this is why even though his imagination was educated, stimulated and guided by mathematics it still took him ten years to find the appropriate mathematical language to express his vision of the space-time continuum of light. Furthermore, it took him another eleven years (1916) after his miraculous year of 1905 to establish his groundbreaking laser theory, which was experimentally verified in the microwave region of the electromagnetic spectrum with the maser in 1954 and brought to fruition in the optical region in 1960 with the ruby laser. Eight years later he followed up with the implicit visual idea of coherency in atomic matter in the 1924 paper on the Bose-Einstein Condensation, which was experimentally verified and made explicit in 1995. This quantum paper, in turn, gave us the atomic laser in 1997, from where our atomic clocks are now derived. The National Institute of Standards and Technology (NIST-F1) contributes to the international group of atomic clocks that define Coordinated Universal Time (UTC), the official world time. Because NIST-F1 is among the most accurate clocks in the world, it makes UTC more accurate than ever before. According to NIST scientist; "One of the most exciting and significant inventions of the 20th century is the laser. The differences between laser light and the light from, for example, an incandescent lamp, are apparent to anyone who has seen a laser pointer. The laser emits a narrow beam of "collimated" light, that is, light that does not spread out much, even when projected across a large auditorium. By contrast even the best flashlight beam spreads significantly in a short distance. The laser light is very pure in color (usually red), but the lamp emits white light, a jumbled mixture of all the colors of the rainbow. Less apparent, but just as important, is that the light waves from the laser are all in step, like a well-trained drill team marching in strict cadence, while the light bulb emits waves in a haphazard manner, like a crowd of disorderly school children running across a playground.

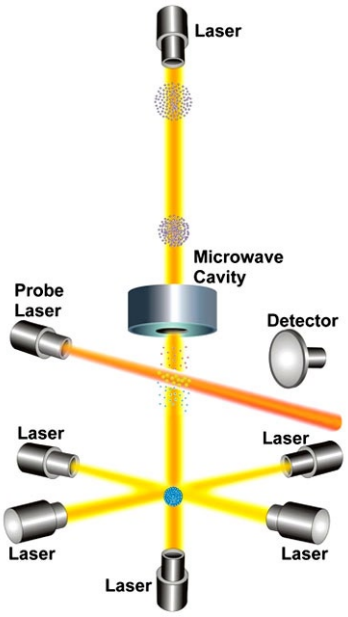


Figure 196. NIST--F1 is referred to as a fountain clock because it uses a fountain-like movement of atoms to measure frequency and time interval. First, a gas of cesium atoms is introduced into the clock's vacuum chamber. Six infrared laser beams then are directed at right angles to each other at the center of the chamber. The lasers gently push the cesium atoms together into a ball. In the process of creating this ball, the lasers slow down the movement of the atoms and cool them to temperatures near absolute zero. Credit: courtesy of NIST[549]

A Well Collimated Quasi-Continuous Atom Laser

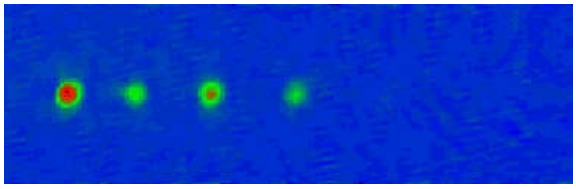


Figure 197. A series of three pulses of atoms, extracted from the Bose-Einstein condensate on the extreme left have traveled to the right without any significant spreading. Credit; courtesy of NIST,

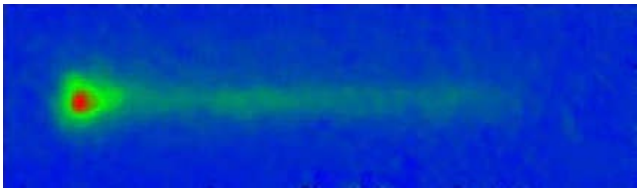


Figure 198. A series of 140 overlapping pulses form a continuous, well collimated atom laser beam, which moves to the right at 6 cm/s.

Beams of atoms have much in common with beams of light. Each can be thought of as a stream of particles (called photons in the case of light), or as a beam of waves. Until recently, however, atomic beams have always been like the light beams from flashlights--a disorderly jumble of different waves, not the orderly "coherence" of a laser beam. The 1995 achievement of Bose-Einstein condensation in the laboratory of Eric Cornell and Carl Wieman of JILA, a joint program of the Commerce Department's National Institute of Standards and Technology and the University of Colorado at Boulder, changed all that. A Bose-Einstein condensate is a collection of atoms all in the same quantum state. That means that all the atoms are doing exactly the same thing, much as all the light inside a laser is doing the same thing, with all the waves marching in step. When atoms are drawn out of a Bose-Einstein condensate, they can form a beam of atoms that is like a laser beam. Such a beam is as different from ordinary atomic beams as lasers are from light bulbs. An "atom laser" was first made in the laboratory of Wolfgang Ketterle at MIT in Cambridge MA in 1997.

In our laboratory at NIST in Gaithersburg MD we have made a significant advance in the art of atom lasers. The MIT atom laser produced a series of pulses of atoms, with each pulse spreading out in an expanding arc, like the ripples on a pond into which a series of rocks is thrown. The effect was the same as if one held a diverging lens in front of a laser beam, causing it to spread out, instead of remaining as a narrow, collimated beam. We modified the process of extracting the atoms so that the spreading became negligible--not much worse than in a usual laser pointer. In addition, we pulse the laser so quickly that the pulses overlap, effectively making a continuous beam of atoms. The key to our method is that it kicks the atoms out in a chosen direction with a chosen speed, while the older method caused the atoms to trickle out under the influence of gravity. Just as some advanced lasers can be "tuned" to deliver different colors of light, our technique allows the atom laser to be tuned to deliver different velocity atoms. As when the laser was invented 40 years ago, the potential applications of the atom laser may not be apparent, but some of them can be anticipated. Atom interferometers, devices that use the wave-like properties of atoms, may be significantly improved by the use of laser-like atomic beams. This could allow improved measurements of gravity or make for better inertial navigation. The invention of lasers ushered in the common use of holographic imaging, and atom lasers may do the same for atom holograms, possibly allowing advances in lithography--the process by which ultra miniature electronic circuitry is made."[550]

Finally, in 1935, Einstein gave us his last successful contribution on light, titled "Can quantum mechanical description of reality be considered complete?"[551] Through the evolutionary critique of this last document, laser physicists have developed our current experience with laser entanglement, which was experimentally verified in 1983 and gave us quantum computing, quantum cryptography and atomic teleportation today. And so in his most productive period, 1905 to 1935, he placed light at the center of physics, thereby enabling our current quantum science to empower mankind with the most useful visual instruments ever invented. We can now ask, what is the nature of this light? And get a coherent answer, provided we give Einstein a legitimate voice in our quantum discourse. The image-making faculty of Einstein's visual sense thereby informed and guided the evolution of our laser intelligence. Einstein's visual thinking in this sense initiated what Dr. David Nolte designates as "a new kind of intelligence," or Mind of Light. What started as Leibniz's proposal for a universal language is now completed. Thanks to Dr. Nolte's vision of a "universal language of visual symbols," Leibniz's dream can now be developed and expressed through the parallel advantage of lasers and their holographic images. Dr. Nolte's discovery extends and applies to the visual sense, the results of the New Principia of Whitehead and Russell. "Two centuries after Leibniz formed his ideal of a symbolic language of human thought and knowledge, a thorough and complete effort to establish such a language was completed. Beginning with simple definitions and laws, the Principia moves upward into ever more complex constructions and derivations of logical propositions and relations—all in an unambiguous visual notation, requiring no words or "language." [552]

The Principia Mathematica is a three-volume work on the foundations of mathematics, written by Alfred North Whitehead and Bertrand Russell and published in 1910–1913. It is an attempt to derive all mathematical truths from a well-defined set of axioms and inference rules in symbolic logic. One of the main inspirations and motivations for the Principia was Frege's earlier work on logic, which had led to some contradictions discovered by Russell. These were avoided in the Principia by building an elaborate system of types: a set has a higher type than its elements and one cannot speak of the "set of all sets" and similar constructs which lead to paradoxes (see Russell's paradox).[553] In mathematics, an axiomatic system is any set of axioms from which some or all axioms can be used in conjunction to logically derive theorems. A mathematical theory consists of an axiomatic system and all its derived theorems. An axiomatic system that is completely described is a special kind of formal system; usually though the effort toward complete formalization brings diminishing returns in certainty and a lack of readability for humans. Therefore, any discussion of axiomatic systems is normally only semiformal. A formal theory typically means an axiomatic system, for example, formulated within model theory. A formal proof is a complete rendition of a proof within a formal system. [554]

Russell's visual notation symbolizes the ultimate state of axiomatic abstraction in which the consciousness of an accomplished axiomatician is elevated. In this visual state of consciousness the empty structures of logical symbols are filled with a superior insight of the coherent universe. This is the mirror image of how Einstein described his method of thinking. Psychologist Robert B. Dilts says that "Einstein claimed to think primarily in terms of visual images and feelings . . . Verbal and mathematical representation of his thoughts came only after the important creative thinking was done." In fact, Einstein attributed his scientific prowess to what he called a "vague play" with "signs," "images," and other elements, both "visual" and "muscular." "This combinatory play," Einstein wrote, "seems to be the essential feature in productive thought." Regarding his Theory of Relativity, Einstein told Max Wertheimer (The founder of Gestalt theory), "These thoughts did not come in any verbal formulation. I very rarely think in words at all." [555] Einstein's radiant thoughts are therefore deeply rooted in a visual language that is grounded in the space-time continuum of light. For Einstein when a connected and recurrent picture emerges in the stream of thought it is through that picture that the ordering and creation of a continuum becomes thinking.[556] In his own words Einstein ponders and answers this fundamental question.

'What, precisely, is "thinking"? When, at the reception of sense impressions, memory-pictures emerge, this is not yet "thinking." And when such pictures form series, each member of which calls another, this too is not yet "thinking." When, however, a certain picture turns up in many such series, then—precisely through such return—it becomes an ordering element for such series, in that it connects series which in themselves are unconnected. Such an element becomes an instrument, a concept. I think that the transition from free association or "dreaming" to thinking is characterized by the more or less dominating role which the "concept" plays in it. It is by no means necessary that a concept must be connected with a sensorily cognizable and reproducible sign (word); but when this is the case thinking becomes by means of that fact communicable."[557]

The emergence of Dr. Noltes axiomatic mirror of Einstein's Mind of Light implies that our current computational theory of Mind not only converges but is also capable of capturing and systematizing Einstein's visual thinking mode. According to Dr. Nolte the critical weakness of the verbal language is the human comprehension bottleneck it produces. "The way a system 'thinks' reflects the architecture of the system, which is to say, different structures 'think' in different ways." The linguistic structure processes information in a serial or linear format (2 dimensions x and t), one word or sentence sequentially and discretely, while the visual structure processes information in parallel mode or one whole image at once (4 dimensions x, y, z and t), continuously. The verbal rate of understanding is very slow, while the visual rate is super fast. When the visual signal is transduced into the bio-electric-chemical nerve impulse or verbal code, the speed of light (300,000 meters per second) is reduced to the cellular speed of 3 meters per second. This linguistic bottleneck is precisely what non-biological laser intelligent model building will revolutionize, reverse or, better, yet eliminate. The laser intelligence of the upcoming optical computer vision system that humanity will be able to upgrade to "promise abstract and associative 'reasoning,' based on images and symbols that exist within a language of spatial and spectral (color) relationships."[558]

The evolutionary, biological and social-educational problem is that the visual mode of educating, which is primary, has become subservient to the verbal mode. In Reading Images: the Grammar of Visual Design, by Gunther Kress, there is a very interesting clarification of how the subversion occurred. "Prior to this step (in reality a development spanning millennia) there are two forms or media of representation. One is language in the form of speech, the other the visual image, or visual marks. Each serves a particular set of purposes (recording/construction of histories, myths, interactions, etc.; recordings of objects, transaction, etc.). In the case of

some cultures, however, the one form of representation 'takes over' the other, as a means of recording. That is, visual representation becomes specialized to function as a means of the visual representation of speech: perhaps in highly organized and bureaucratized societies. The visual has then been subsumed, taken over, by the verbal. Consequently, it's former possibilities and its potential for independent representation decline and withers away."[559]

It is important to recognize that it was with the invention of writing and the spread of writing systems around 3500 B.C.E that the subversion of the visual by the verbal happened. Prof. Goldman further clarifies the historical change. "The invention of writing in the 4th millennium B.C.E. in Sumer is the expression of an idea, coming after millennia of increasingly complex social interaction. It entailed the creation of a system of signs that evolved from idea-pictures to an alphabet and initiated a line of influence that, via Greece and Rome, links Sumerian cuneiform inscriptions on clay tablets to Internet-disseminated scientific journals." [560] Prof. Goldman traces the origin and evolution of the western idea of science to the writing system. For him science without writing is inconceivable. [561] However, Socrates in Plato's dialogue Phaedrus presented a serious critique of the consequence of this visual, living and dialectical thought reversal with his argument against writing. "They go on to discuss what is good or bad in writing. Socrates tells a brief legend, critically commenting on the gift of writing from the Egyptian god Theuth to King Thamus, who was to disperse Theuth's gifts to the people of Egypt. After Theuth remarks on his discovery of writing as a remedy for the memory, Thamus responds that its true effects are likely to be the opposite; it is a remedy for reminding, not remembering, he says, with the appearance but not the reality of wisdom. Future generations will hear much without being properly taught, and will appear wise but not be so, making them difficult to get along with.[57] No written instructions for an art can yield results clear or certain, Socrates states, but rather can only remind those that already know what writing is about.[58] Furthermore, writings are silent; they cannot speak, answer questions, or come to their own defense.[59] Accordingly, the legitimate sister of this is, in fact, dialectic; it is the living, breathing discourse of one who knows, of which the written word can only be called an image.[60]The one who know use the art of dialectic rather than writing." [63][562]

Figure 199. The cuneiform script (pronounced /kjuniəfrm/) is one of the earliest known forms of written expression. Created by the Sumerians about 3000 BC (with predecessors reaching into the late 4th millennium or about the period[1] of Uruk IV), cuneiform writing began as a system of pictographs. Over time, the pictorial representations became simplified and more abstract. The image above shows the development of the sign SAG "head" (Borger nr. 184, U+12295 □). Stage 1 shows the pictogram as it was drawn around 3000 BC. Stage 2 shows the rotated pictogram as written around 2800 BC. Stage 3 shows the abstracted glyph in archaic monumental inscriptions, from ca. 2600 BC, and stage 4 is the sign as written in clay, contemporary to stage 3. Stage 5 represents the late 3rd millennium, and stage 6 represents Old Assyrian ductus of the early 2nd millennium, as adopted into Hittite. Stage 7 is the simplified sign as written by Assyrian scribes in the early 1st millennium, and until the script's extinction. Courtesy of Wikipedia.[563]

Socrates was correct in pointing out that genuine knowledge does not reside in the book but inside the living, breathing and thinking brain as Drucker would attest. The written book at its best only reminds us about a linearly selected thought stream that the author carefully imprinted at a particular time and space, in that format. What Socrates is telling us is that we should be mindful not to substitute memory, talk, presentation, writing or any form of representation for the living reality of thought that electro-magnetically flows through our living brain. This thought brings us right back to the knowing-doing gap. It is absolutely crucial that a represented thought be actively integrated into the living stream of your consciousness for it to be effectively truthful and useful. Of course not every thought that we encounter in the theatre of perception is worthy of being adopted or integrated into our intimate stream of thought or experience. This is why we need to cultivate a highly critical faculty of reason and judgment. This is what visual thinking excels at, because it helps us see the actual image of the represented thought, as we saw with Einstein.

Thomas G. West in his powerful new book, Thinking like Einstein, Returning to Our Visual Roots with the Emerging Revolution in Computer Information Visualization,[564] highlights exactly what the Laser Informed Vision is essentially about. He gave a clear illustration of visual thinking and learning when he quoted the work of W. Davis, H. Porta, and J. Uhl, in Calculus & Mathematica[565]

"One of the beauties of learning the Calculus & Mathematica way is your opportunity to learn through graphics you can interact with. In this course, your eyes will send ideas directly to your brain. And this will happen without the distraction of translating what your eyes see into words. Take advantage of this opportunity to learn visually with pure thought uncorrupted by strange words. The words go onto an idea only after the idea has already settled in your mind. This aspect of Calculus & Mathematica distinguishes it from other math courses. There are several stages in this learning process. Visual learners can frequently grasp the concepts before they can put them into words. Then they can describe the concepts in words for others to understand. Finally, to do serious calculations, they must be able to translate those pictures and words into mathematical actions. Don't forget that final stage." However because of the proprietary license of Mathematica and its expense I do not recommend using it, instead go for SAGEMATH: Open Source Mathematics Software who created a viable free open source alternative to Magma, Maple, Mathematica, and Matlab. With SAGE you get general and advanced, pure and applied mathematics. Use SAGE for studying a huge range of mathematics, including algebra, calculus, elementary to very advanced number theory, cryptography, numerical computation, commutative algebra, group theory, combinatorics, graph theory, and exact linear algebra.[566]

One of the best definitions of the visual cognitive faculty I develop in this book is found in a seminal work called Visual Thinking by Rudolph Arheim,[567] Professor Emeritus of the psychology of art at Harvard University. "My contention is that the cognitive operations called thinking are not the privilege of mental processes above and beyond perception but the essential ingredients of perception itself. I refer to such operations as active exploration, selection, grasping of essentials, simplification, abstraction, analysis and synthesis, completion, correction, comparison, and problem solving, as well as combining, separating, and putting into context. These operations are not the prerogative of any one mental function; they are the manner in which the minds of both man and animal treat cognitive material at any level. There is no basic difference in this respect between what happens when a person looks at the world directly and when he sits with his eyes closed and thinks. By cognitive I mean all mental operation involved in the receiving, storing and processing of information: sensory perception, memory, thinking, learning."

My primary objective in this visual and verbal book is therefore to open our laser-informed eyes—that is, the visual coherence of cognition within the visual cortex—to the coherent light of life that is radiating its pure thoughts from a coherent quantum world. This visual book focuses the universal power of VRD's new laser intelligence on the readers' mind's eye so that it may strengthen the competence of the visual thinker. I regard the visual thinker as an individual endowed by scientific reason with the right[568] to an everlasting healthy life, with economic and intellectual liberty as well as the happiness that comes from visually knowing the brilliant Laser Informed World that is emerging for our well being. It is precisely through Geothermal power that we can liberate the Open Resource-Based Economy--- emerging with the MIT OCW program and UNESCO's Virtual University—from the pollution of the oil based economy, created by the state capitalist system of a Superclass (The Global Power Elite) and their monetary inequality.[569]

In general, the laser started out as a solution looking for a problem, but has now turned out to be the possible solution to all our problems. More specifically, it is the LaserFusion power solution for a laser-informed world and its knowledge workers participating in an open resource based knowledge society. The extension or connection of LaserFusion power to the Lambdasphere (Maser/laser in the geomagnetic sphere) also emerged from my proportional vision. As you know the Lambdasphere (section 2.5) is a fiber optics term invented by George Gilder.[570] Even though Gilder applies the term mostly to the telecommunication industry or telecosm, the neologism of Lambdasphere was extended in this study to the whole universe. This extension or continuum of our laser intelligence goes from the human genome—that was accelerated and completed with laser technology—to our laser informed brains. With our brains augmented by Microvision's VRD, we will extract, convert and amplified the geothermal power in the Core of the Earth to our homes with the Laser Drill. We will install and control our LaserEmpowered Homes with Fiber Optics to the Home (FTTH) and in the home (FITH) with JDSU'S photonics powerline network. With our laser intelligence now producing unlimited clean laser energy we will now connect it and distribute it through the photonic powerline network to the all-optical laser Internet.

Through this laser empowered global Internet we are enabling our laser intelligence to connect with the geomagnetic sphere (Aurora Borealis and Australis) and its "Electron Cyclotron Maser, which is like a natural laser except at radio frequencies." Through the interplanetary electron cyclotron maser in the geomagnetic sphere we will extend our laser intelligence to the solar system and its coherent connection to the fusion plasma of the laser stars within our Milky Way galaxy. And through these laser fusion stars (the most powerful lights in the universe) we will connect our laser intelligence to the coherent cosmic background radiation (the oldest light of the universe). And, finally, through this coherent global connection we will inject, awaken, re-create and direct the universe with our laser Intelligence. The Lambdasphere actually emerged as you know from Einstein's visual laser tradition. This global laser thesis is best illustrated by a proportional thought structure: mankind's rational thought is to the real world what Einstein's Laser informed Vision is to the Lambdasphere. The global laser thesis can also be visualized as Einstein's radiant thoughts being captured by our visual cortex via the virtual retinal display on the Internet in the form of a coherent quantum rainbow of lasers. Einstein's laser intelligence is now projected globally through the Lambdasphere unto the whole universe. This coherent quantum rainbow of lasers illustrates Ray Kurzweil's reverse spiral of the Law of Time and Chaos, which he called the inverse Sub Law of Accelerating Returns: As order exponential increases, time exponentially speeds up. In an evolutionary process, it is order—the opposite of chaos—that is increasing. In a chaotic thermodynamic system, time is asymmetrical (past to future); in an ordered quantum system, time is symmetrical (future to past). In his powerful book, The Singularity is Near, When Humans Transcend Biology (Viking Penguin 2005), Dr. Kurzweil brought to fruition his vision of the evolution of intelligence.[571]

Figure 200, Spin wallpaper from Pangolin LaserDesign Systems. The spiral is the fundamental structure of our universe, our brains and our DNA. Credit; courtesy of Pangolin.

The Laser informed thesis emerged from a profound reflection on the quantum optics of the ruby laser. The ruby crystal laser is significant because it was the first medium—that contained the fluorescent properties of photons, which are a precondition for lasing used to unleash the Lambdasphere. Through it on May 16, 1960, Theodore Maiman gave birth to Einstein's powerful conception of the laser theory. In his own words, Maiman conveys the excitement of that very special instant of the birth of the laser via the electromagnetic presence of the number 950. "When we got past 950 volts on the power supply, everything changed! The output trace started to shoot up in peak intensity and the initial decay time rapidly decreased. Voila. This was it! The Laser was born!"[572] And now thanks to his application of Einstein's law of coherent light, this powerful light is now available to all mankind as such. Moreover, it was Einstein's focus on the coherent light of nature that helped mankind to realize the true value of Galileo's problem of the light. In The Evolution of Physics, Einstein and Infeld stated that "Galileo formulated the problem of determining the velocity of light, but he did not solve it. The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle, require creative imagination and marks real advance in science."[573]

Just as Galileo's visualization and mathematization of the light of nature enabled Einstein to access the coherent light of nature, so Einstein enabled Maiman to appropriate for us the universal message of lasers and made it accessible for us today. Galileo was to Einstein what Einstein was to Maiman; this was the proportional vision that guided the development of my inquiry into the Lambdasphere. The laser community inherited this coherency from Einstein and Maiman and it is our responsibility to transmit it to all humanity and to the entire universe. The Laser informed thesis within Einstein's coherent quantum tradition has yielded not only a new understanding of the laser but, more important, a new way of living its message. This book intends to fulfill this new understanding and to provide the means to realize this new living via Microvision's VRD. The Laser information book is now directing humanity's growing laser body of knowledge to the informed life of the Lambdasphere, the emerging new world of laser intelligence.

Figure 201. Microvision's wearable "augmented vision" display, as they describe it, is incorporated into eyeglasses, goggles or helmets. Microvision's technology display is a computer image that doesn't block the user's view but instead superimposes a high-contrast monochromatic or color image on top of it. This ability can enhance the safety, precision and productivity of professionals performing complex tasks. Credit: courtesy of Microvision.

Microvision's VRD is only the initial phase of the advent of augmented reality in which the full potential of a visual thinker is realized. With Microvision's enrichment of our laser-empowered eyes three conceptual spaces are integrated into our lived perceptions: Einstein's LaserEmpowered Vision, the all optical network platform and Dr. Nolte's dynamic holographic intelligent principles and universal visual language. Our laser-empowered eyes will employ the continuous laser with this dynamic holographic technique to bring the intelligence of lasers directly into our brains via the neural network of the retina. And with our laser-empowered eyes fully opened we will see and live in the Lambdasphere. The implications of this historical event for the world of laser information processing are staggering. In The Age of Spiritual Machines, When Computers Exceed Human Intelligence, by Ray Kurzweil, I encountered the best description of the visual programmer and his or her creative potential: "The computer programmer is a creator of universes for which he alone is the lawgiver. . . . No playwright, no stage director, no emperor, however powerful, has ever exercised such absolute authority to arrange a stage or a field of battle and to command such unswervingly dutiful actors or troops." We can now coherently transduce the American global empire.

A reflection on the interaction of the VRD with the human brain puts us face to face with that grand architect of our civilization, the visual faculty of reasoning and its coherent imagination. The augmentation of this precious faculty with the VRD via the Open Solutions framework and MIT's OCW brings to fruition a new generation of software designers. The open developer analogy with an architect's design of a home, building or a city equally applies to the LaserEmpowered Vision of the 3D transformations or visualization pipeline. This idea converges with the science of computer graphics."Computer graphics is a sub-field of computer science and is concerned with digitally synthesizing and manipulating visual content. Although the term often refers to three-

dimensional computer graphics, it also encompasses two-dimensional graphics and image processing. Computer graphics is often differentiated from the field of visualization, although the two have many similarities. Computer graphics broadly studies the manipulation of visual and geometric information using computational techniques. Computer graphics as an academic discipline focuses on the mathematical and computational foundations of image generation and processing rather than purely aesthetic issues.

A broad classification of major subfields in computer graphics might be:

• Geometry: studies ways to represent and process surfaces

• Animation: studies with ways to represent and manipulate motion

• Rendering: studies algorithms to reproduce light transport

• Imaging: studies image acquisition or image editing."[574]

With the VRD there is now a profound convergence between computer vision and human vision. The open programmer now works directly with the human visual cortex. All his or her programs are displayed not by external liquid crystal display (LCD) or cathode ray tube (CRT) screens but by the internal visual system of the human eyes. This is a very significant development in the history of computer programming. The implications for 3D animation, simulations, visualization, virtual reality, augmented reality and functionally equivalent recreations are extraordinary. Ray Kurzweil's inverse sub law of accelerating returns for the human brain and the start of the singularity (Epoch 5: the merger of technology and humanity) is visually here. "By the end of this decade, computing will disappear as a separate technology that we need to carry with us. We'll routinely have high-resolution images encompassing the entire visual field written directly to our retinas from our eyeglasses and contact lenses (the Department of Defense is already using technology along these lines from Microvision, a company based in Bothell, Washington).[575] "Visualization is any technique for creating images, diagrams, or animations to communicate a message. Visualization through visual imagery has been an effective way to communicate both abstract and concrete ideas since the dawn of man. Examples from history include cave paintings, Egyptian hieroglyphs, Greek geometry, and Leonardo da Vinci's revolutionary methods of technical drawing for engineering and scientific purposes. Visualization today has ever-expanding applications in science, education, engineering (e.g. product visualization), interactive multimedia, medicine , etc. Typical of a visualization application is the field of computer graphics. The invention of computer graphics may be the most important development in visualization since the invention of central perspective in the Renaissance period. The development of animation also helped advance visualization.[576]

Figure 202. VRD full Spectrum version. Credit, Courtesy of Microvision

And finally with Einstein's Laser Informed Vision integrated with the MIT OCW program for the development of a visual language of lasers and the LaserFusion power system our mission will be consistent and completed. The coherent fusion between the objective and subjective worlds will be realized and the knowing-doing gap will be eliminated. The coupling of the Microvision VRD to the MIT OCW curriculum is perhaps the best way to leverage the power of the coherent global brain. Software development, administration, services and maintenance with the open platform and the VRD is motivated by three key words: integration, in-depth and intensity. The MITOCW/VRD approach to technical education is based on an understanding of the open and peer to peer platform and its productive application to the LaserFusion Power system. With the integration of the VRD to education, we can experience a profound shift in awareness owing to the heightened sense of well being that comes from the personal laser power. We can feel young, healthy, wealthy and wise. Our self-esteem will soar because we can successfully apply the balanced combination of analytical, creative and practical intelligence.[577] I consider the MITOCW/VRD method the most effective way to master a college curriculum. MIT/VRD produces real value when it serves as a master information provider by locating, filtering and communicating to us what is truly useful to focus on. This brings to the foreground a book titled Focus; The Future of Your Company Depends on It, by Al Ries. In brief, success depends on doing what you do best—and expanding from there. It means staking out a narrow focus on your expertise or talent by aligning everything within your organization to serve its mission, collaborate with your specific market position and integrate it to the global net. With access to MITOCW and our embrace of the VRD, higher education is now firmly established not only on the laser infrastructure of the Internet (the Lambdasphere) but, more importantly, in the highest intellectual function of the human brain, the imaginative and moral faculty of the visual cortex.

Part 3.9. How Einstein's Visual Conception of the Laser became our Living Perception with the VRD for Education in the ORBE

Figure 203. Credit courtesy of Microvision

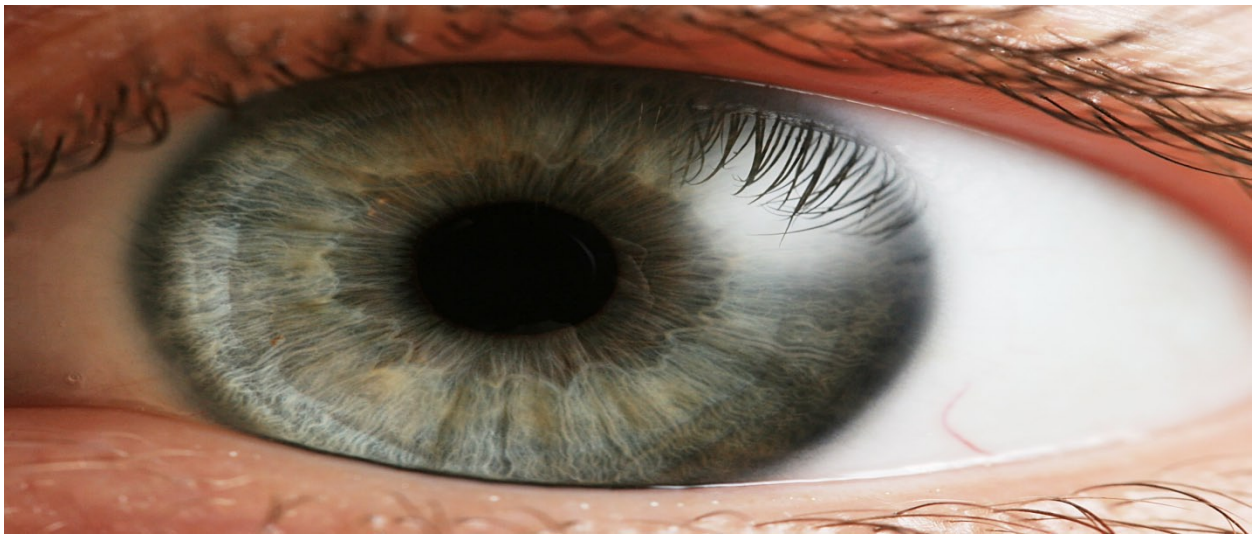


Figure 204. Eyes are organs that detect light. In the human eye, light enters the pupil and is focused on the retina by the lens. The lens is a transparent, biconvex (lentil-shaped) structure in the eye that, along with the cornea, helps to refract light to be focused on the retina. Its function is thus similar to a human-made optical lens. The lens is also known as the aquula (Latin, a little stream, dim. of aqua, water) or crystalline lens. In the retina are light-sensitive nerve cells called rods (for brightness) and cones (for color) that react to the light. They interact with each other and send messages to the brain that indicate brightness, color, and contour.[578] Credit: courtesy of Wikipedia.

It was Einstein's metaphysical, physical and mathematical influence on our understanding of light that cleared the way for a real biosynthesis between our biological internet (the 60 trillion cells of the human body) and the Coherent Light of Science that is populating the biosphere as the Lambdasphere (the all-optical infrastructure of the universe and the internet). As I was tracing Einstein's Laser Informed Vision and the coherent quantum tradition that it has generated, the notion of laser informed eyes emerged in me. It was more precisely from the homological (structurally identical) recognition that the human retina has all the characteristics of the laser transduction process (conversion of incoherent light into coherent light) or stimulated emission and absorption that the realization came to me. "In physics, the photon is the elementary particle responsible for electromagnetic phenomena. It is the carrier of electromagnetic radiation of all wavelengths, including gamma rays, X-rays, ultraviolet light, visible light, infrared light, microwaves, and radio waves. The photon differs from many other elementary particles, such as the electron and the quark, in that it has zero rest mass;[3] therefore, it travels (in a vacuum) at the speed of light, c. Like all quanta, the photon has both wave and particle properties ("wave–particle duality"). Photons show wave-like phenomena, such as refraction by a lens and destructive interference when reflected waves cancel each other out; however, as a particle, it can only interact with matter by transferring the amount of energy

$$E = \frac{hc}{\lambda},$$

where h is Planck's constant, c is the speed of light, and λ is its wavelength. This is different from a classical wave, which may

gain or lose arbitrary amounts of energy. For visible light the energy carried by a single photon is around 4×10^{-19} joules; this energy is just sufficient to excite a single molecule in a photoreceptor cell of an eye, thus contributing to vision."[4]579

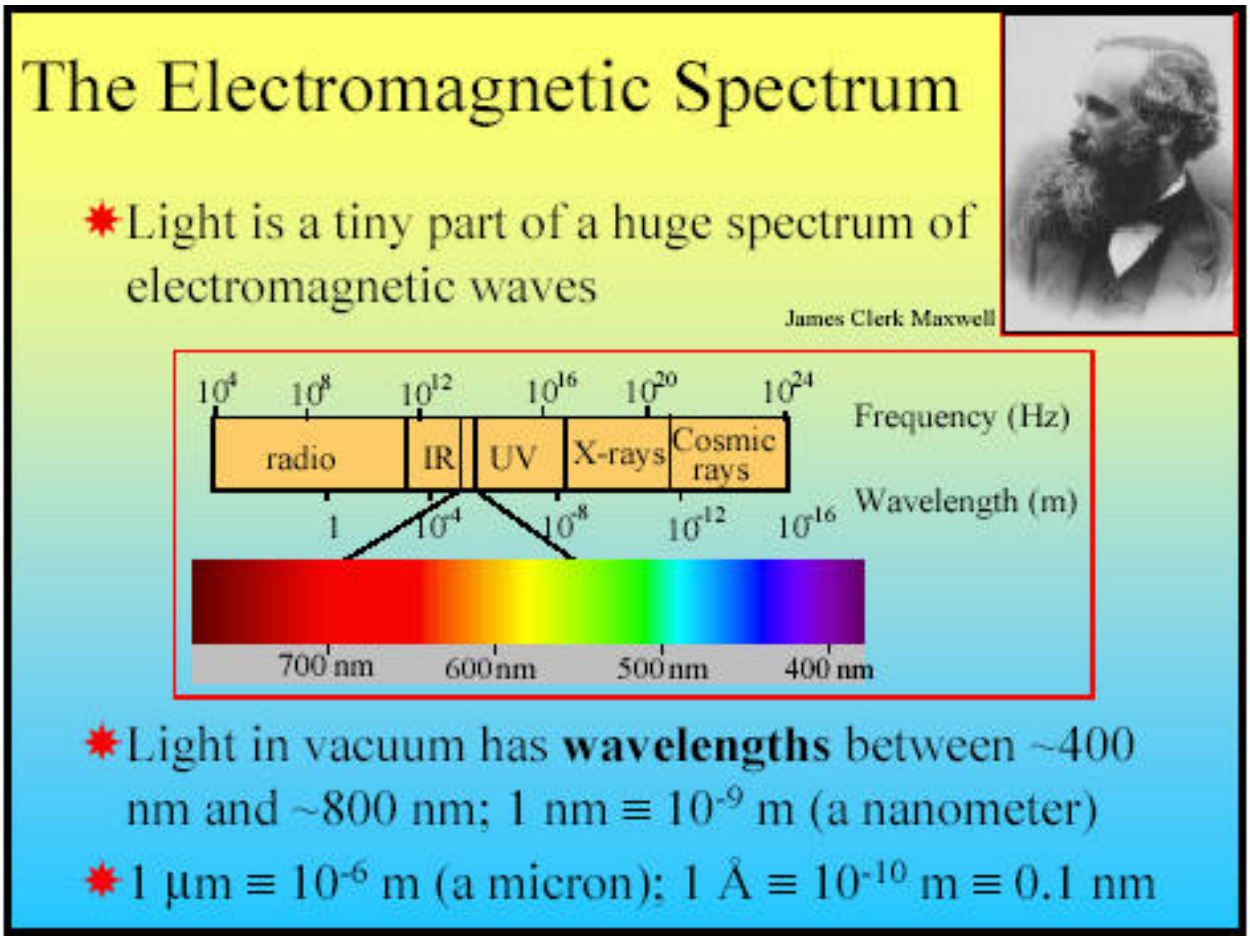


Figure 205

My reading of "Laser Odyssey" by Dr. Theodore Maiman" illuminated the idea that the coherency (the ordered vision of reality) that a healthy brains gives us, actually starts in the retina with the inversion of the image. My Cosmo-biological sense of homology came into view when Maiman talked about the "revered condition of population inversion" as a necessary condition for the laser process. Siegman in his classic book on Lasers gives us more insight into this essential condition of population inversion; "Lasers are devices that generate or amplify coherent radiation at frequencies in the infrared, visible, or ultraviolet regions of the electromagnetic spectrum… If we want, we can think of the basic stimulated transition process as the sum of two separate processes: in one, atoms initially in the lower energy level are stimulated by the applied signal to make transitions upward; in the other, atoms initially in the upper energy level are stimulated by the applied signal to make transitions downward. It is vital to understand, however, that the stimulated –transition probability produced by an applied signal (probability of transition per atom and per second) is always exactly the same in both directions. The net flow of atoms is thus always from whichever level has the larger population at the moment, to whichever level has the smaller population… If the lower level is more heavily populated, the signal is attenuated (absorbed). If the upper level is more heavily populated, the signal is amplified (emitted)… For laser action to occur, the pumping process must produce not merely excited atoms, but a condition of population inversion, in which more atoms are excited into a higher quantum energy level than are in some lower energy level in the laser medium."[580] Maiman's idea of population inversion in the ruby laser medium was followed by the statement that the "magnitude" (the amount of net stimulated emission radiation must exceed the amount of spontaneous emission) should be large enough to overcome the inevitable losses in any practical associated structure (called a resonator)." This idea immediately directed my thoughts to the human eyes. Since our eyes are shaped like a convex lens that act as a magnifying glass. What happens when you put an incoherent (diffused) source of light like the sun (scattered by the atmosphere) under a magnifying glass? You get the necessary focused energy to burn a hole through paper. This focused magnification of the incoherent source in our eyes acts as a high-powered lamp to stimulate the photons in the eyes to the higher ground where they can accomplish the population inversion in the retina. Coherency is clearly the fundamental reason for the inversion of the image in the eyes. According to Maiman only the red axial photons around and paralleled to the ruby crystal axis are the ones responsible for the coherent beam. All other photons are lost or absorbed by the resonator. Those red axial Photons of the ruby laser are structurally identical (homological) to the photons traveling in or paralleled to the crystal axis in the convex lens of our eyes via the fovea, where they invert the image.

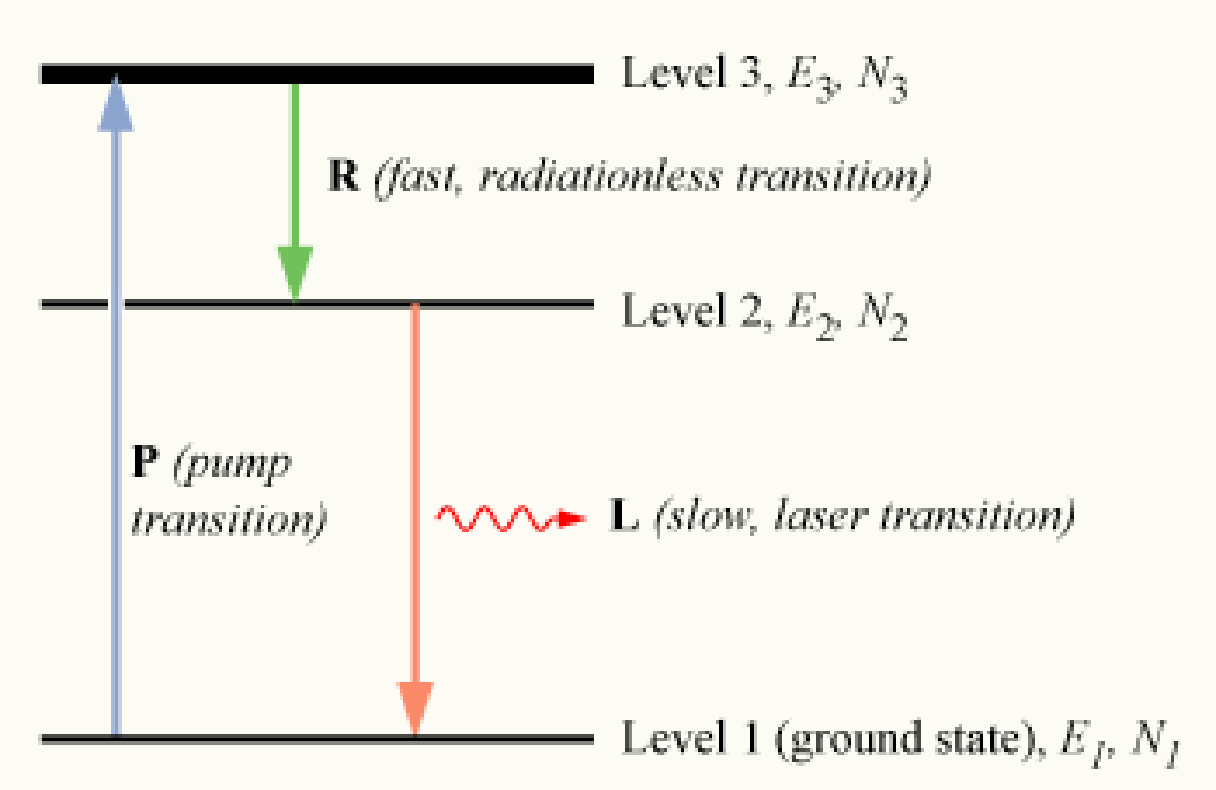


Figure 206. In physics, specifically statistical mechanics, a population inversion occurs when a system (such as a group of atoms or molecules) exists in state with more members in an excited state than in lower energy states. The concept is of fundamental importance in laser science because the production of a population inversion is a necessary step in the workings of a laser.[581]

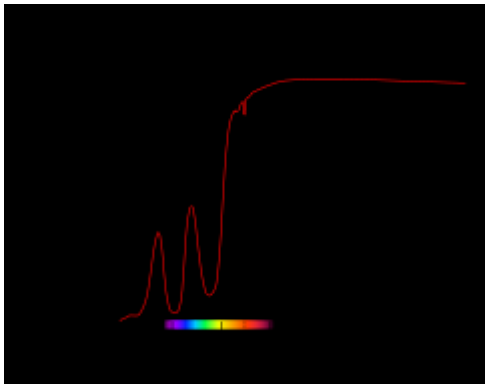


Figure 207. Transmittance of ruby in optical and near-IR spectra. Note the two broad blue and green absorption bands and the narrow absorption band at 694 nm, which is the wavelength of the ruby laser. The ruby laser produces pulses of visible light at a wavelength of 694.3 nm, which appears as deep red to human eyes. Typical ruby laser pulse lengths are on the order of a millisecond. These short pulses of red light are visible to the human eye, if the viewer carefully watches the target area where the pulse will fire. Credit; courtesy of Wikipedia.

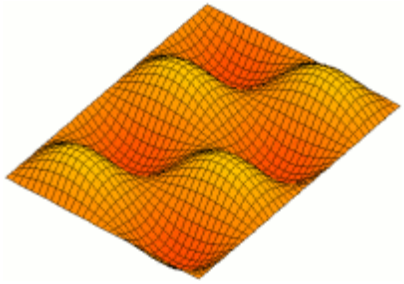


Figure 208. A standing wave in a rectangular cavity resonator A resonator is a device or system that exhibits resonance or resonant behavior, that is, it naturally oscillates at some frequencies, called its resonance frequencies, with greater amplitude than at others. Although its usage has broadened, the term usually refers to a physical object that oscillates at specific frequencies because its dimensions are an integral multiple of the wavelength at those frequencies. The oscillations or waves in a resonator can be either electromagnetic or mechanical. Resonators are used to either generate waves of specific frequencies or to select specific frequencies from a signal. . In a laser, light is amplified in a cavity resonator which is usually composed of two or more mirrors. Thus an optical cavity, also known as a resonator, is a cavity with walls which reflect electromagnetic waves (light). This will allow standing wave modes to exist with little loss outside the cavity.[582] Credit: courtesy of Wikipedia

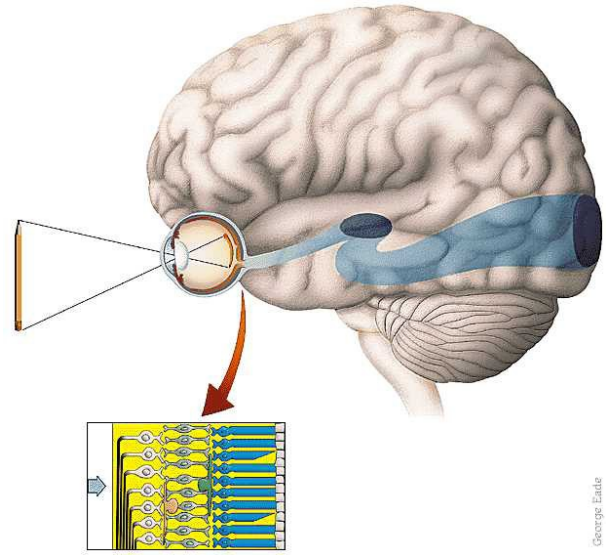


Figure 209. The Human Visual Pathway as shown in the above figure shows the reflected rays of the pencil pass through its lens. The inverted image of the pencil is directly projected onto the retina. The rod and cone cells of the retina are responsible for transmitting signals to the brain through the optical nerve. Image courtesy of Howard Hughes Medical Institute. Credit: courtesy of HITL.

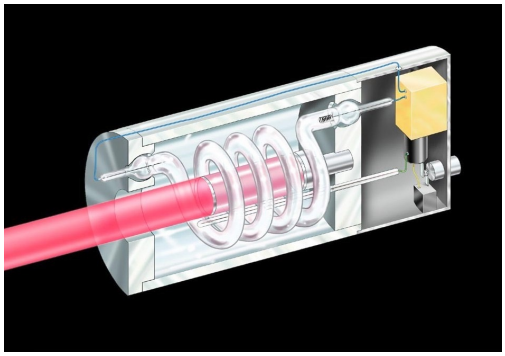


Figure 210. A ruby laser is a solid-state laser that uses a synthetic ruby crystal as its gain medium… The ruby laser is a three level solid state laser. The active laser medium (laser gain/amplification medium) is a synthetic ruby rod that is energized through optical pumping, typically by a xenon flash lamp. In early examples, the rod's ends had to be polished with great precision, such that the ends of the rod were flat to within a quarter of a wavelength of the output light, and parallel to each other within a few seconds of arc. The finely polished ends of the rod were silvered: one end completely, the other only partially. The rod with its reflective ends then acts as a Fabry-Pérot etalon (or a Gires-Tournois etalon). Modern lasers often use rods with ends cut and polished at Brewster's angle instead. This eliminates the reflections from the ends of the rod; external dielectric mirrors then are used to form the optical cavity. Curved mirrors are typically used to relax the alignment tolerances.[583] Credit: courtesy of Laurence Livermore Laboratory.

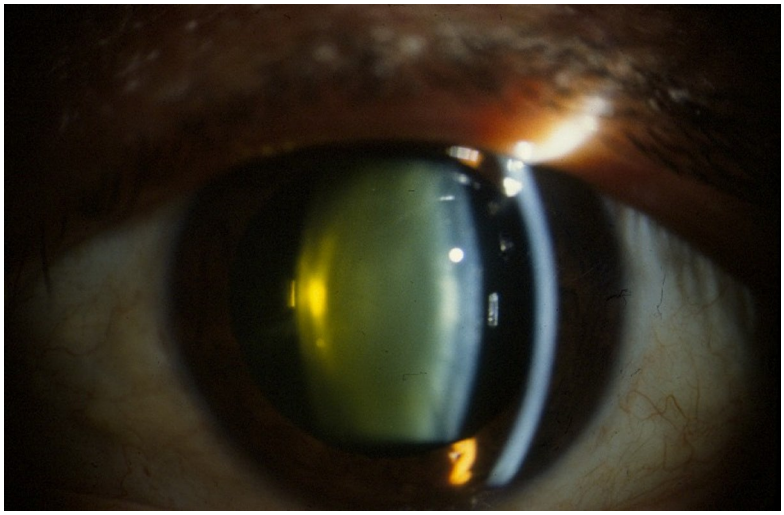


Figure 211. Description: Normal adult lens in cross section (slit lamp picture) Credit: National Eye Institute, National Institutes of Health Ref#: NEA12[584]

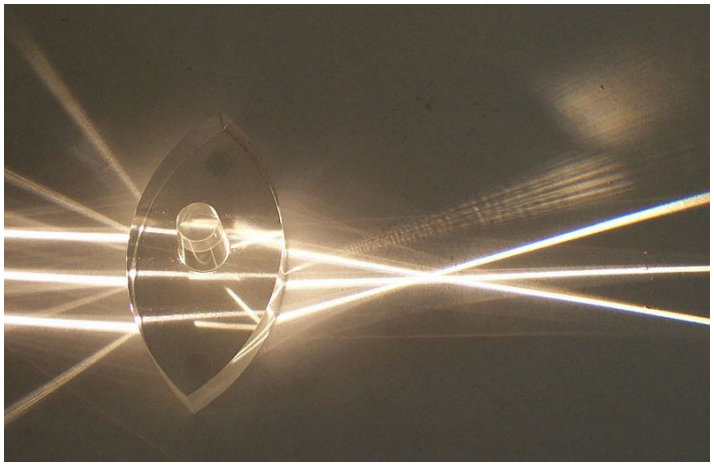


Figure 212. If the lens is biconvex or plano-convex, a collimated or parallel beam of light travelling parallel to the lens axis and passing through the lens will be converged (or focused) to a spot on the axis, at a certain distance behind the lens (known as the focal length). In this case, the lens is called a positive or converging lens.[585] Credit: courtesy of Wikipedia.

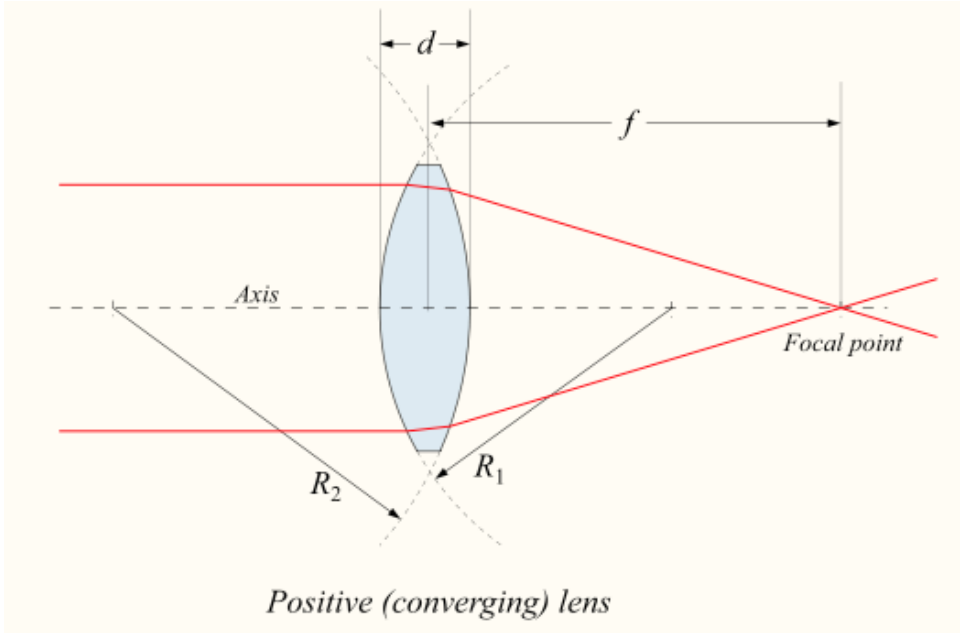


Figure 213. Credit: courtesy of Wikipedia.

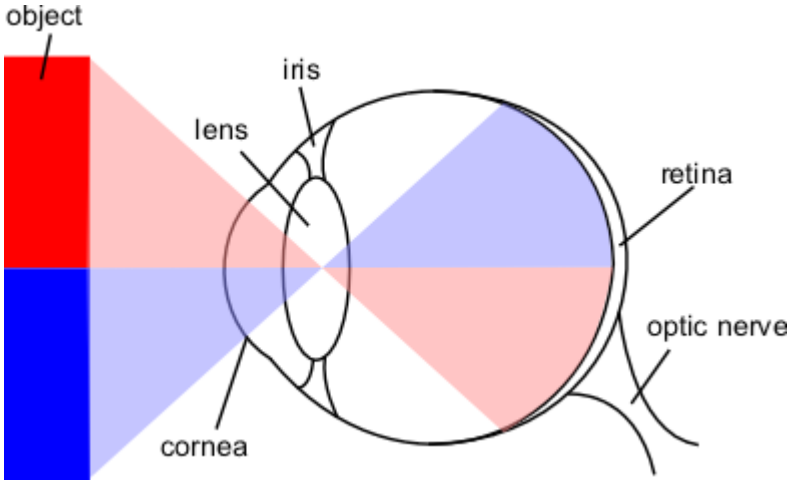


Figure 214. The image projected onto the retina is inverted due to the optics of the eye. Light entering the eye is refracted as it passes through the cornea. It then passes through the pupil (controlled by the iris) and is further refracted by the lens. The cornea and lens act together as a compound lens to project an inverted image onto the retina. Credit: courtesy of Wikipedia.

Now with the advent of Microvision's Virtual Retinal Display (a coherent projection of laser information into our eyes, effectively converting our eyes into a computer monitor) we are able to overcome that inevitable lost of information that occurs in the incoherent transduction process. Moreover, if we bear in mind the first law of thermodynamics or the Conservation of Energy which states that "the total amount of energy never changes; it can only be transferred from one form to another, not created or destroyed, then we can easily see how the photons that fall by the way side are assimilated by the brain as decoherence (an incoherent transition from coherent or incoherent sources).[586] Conservation of Energy in Relativity Theory.With the discovery of special relativity by Albert Einstein, energy was found to be one component of an energy-momentum 4-vector. Each of the four components (one of energy and three of momentum) of this vector is separately conserved in any given inertial reference frame. Also conserved is the vector length (Minkowski norm), which is the rest mass. The relativistic energy of a single massive particle contains a term related to its rest mass in addition to its kinetic energy of motion. In the limit of zero kinetic energy (or equivalently in the rest frame of the massive particle, or the center-of-momentum frame for objects or systems), the total energy of particle or object (including internal kinetic energy in systems) is related to its rest mass via the famous equation E = mc2. Thus, the rule of conservation of energy in special relativity was shown to be a special case of a more general rule, alternatively called the conservation of mass and energy, the conservation of mass-energy, the conservation of energy-momentum, the conservation of invariant mass or now usually just referred to as conservation of energy. In general relativity conservation of energy-momentum is expressed with the aid of a stress-energy-momentum pseudotensor.[587]

By powering the retina with coherent light as is done with the VRD, we are minimizing that inevitable loss of information (decoherence) that occurs in the transduction of incoherency. And simultaneously we are amplifying the coherent signal in the neural network of the visual cortex, thereby fortifying the whole brain. Therefore, my laser informed theory postulates that if the light source is coherent, the burden of incoherency will be alleviated from the retina. This new freedom will allow the brain to more easily achieve an optimal state of cognition. Bruce Caridi, a Rensselaer Polytechnic Institute Engineer and Microvision representative in 2000 stated that "we believe that intensification of the retina with coherent laser light is the key to unleashing the full potential of the brain. In a practical sense, if a device such as the VRD can be used to direct information to the retina using laser light; this could have a profound impact on the cognitive function of the brain. Furthermore, since the brain controls most of our physical bodily functions, the results could be far more reaching. [588]

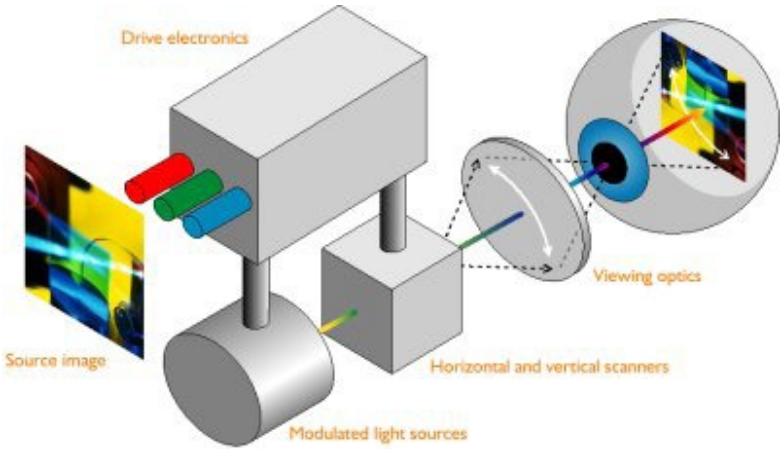


Figure 215. Unlike CRT monitors, the VRD has no phosphorus persistence but, depends on the light-gathering properties of the photoreceptors and the temporal integration properties of the visual system. Therefore, the interactions between the VRD delivered light and the psychophysical image quality created by the brain are of extreme importance for future enhancements. Image courtesy of Microvision

My mission is therefore to bring the coherent quantum infrastructure of Einstein's Law directly into our foreheads through our laser informed eyes which are thereby intensified by the VRD. And so by substituting the incoherent source of light with a coherent source as is done with the VRD we are literally intensifying our visual perception with the foundational light of the universe. Einstein's laser conception is now our perception. The following few paragraphs is a technical description of how the VRD actually works according to Microvision and the Human Interface Lab in Seattle Washington. It is followed by a Wikipedian analysis of the human visual system. "How does the Microvision VRD works? The virtual retinal display scans a low-power beam of light that "paints" an image directly onto a user's retina rather than a screen. Three laser sources (red, green and blue) are combined to provide a full color scale. To create an image with the VRD a photon source (or three sources in the case of a color display) is used to generate a coherent beam of light. The use of a coherent source (such as a laser diode) allows the system to draw a diffraction-limited spot on the retina. The light beam is intensity modulated to match the intensity of the image being rendered. The modulation can be accomplished after the beam is generated or, if the source has enough modulation bandwidth, as is the case with a laser diode, the source can be modulated directly. The resulting modulated beam is then scanned to place each image point, or pixel, at the proper position on the retina. A variety of scan patterns are possible. The scanner could be used in a calligraphic mode, in which the lines that form the image are drawn directly, or in a raster mode, much like standard computer monitors or television.

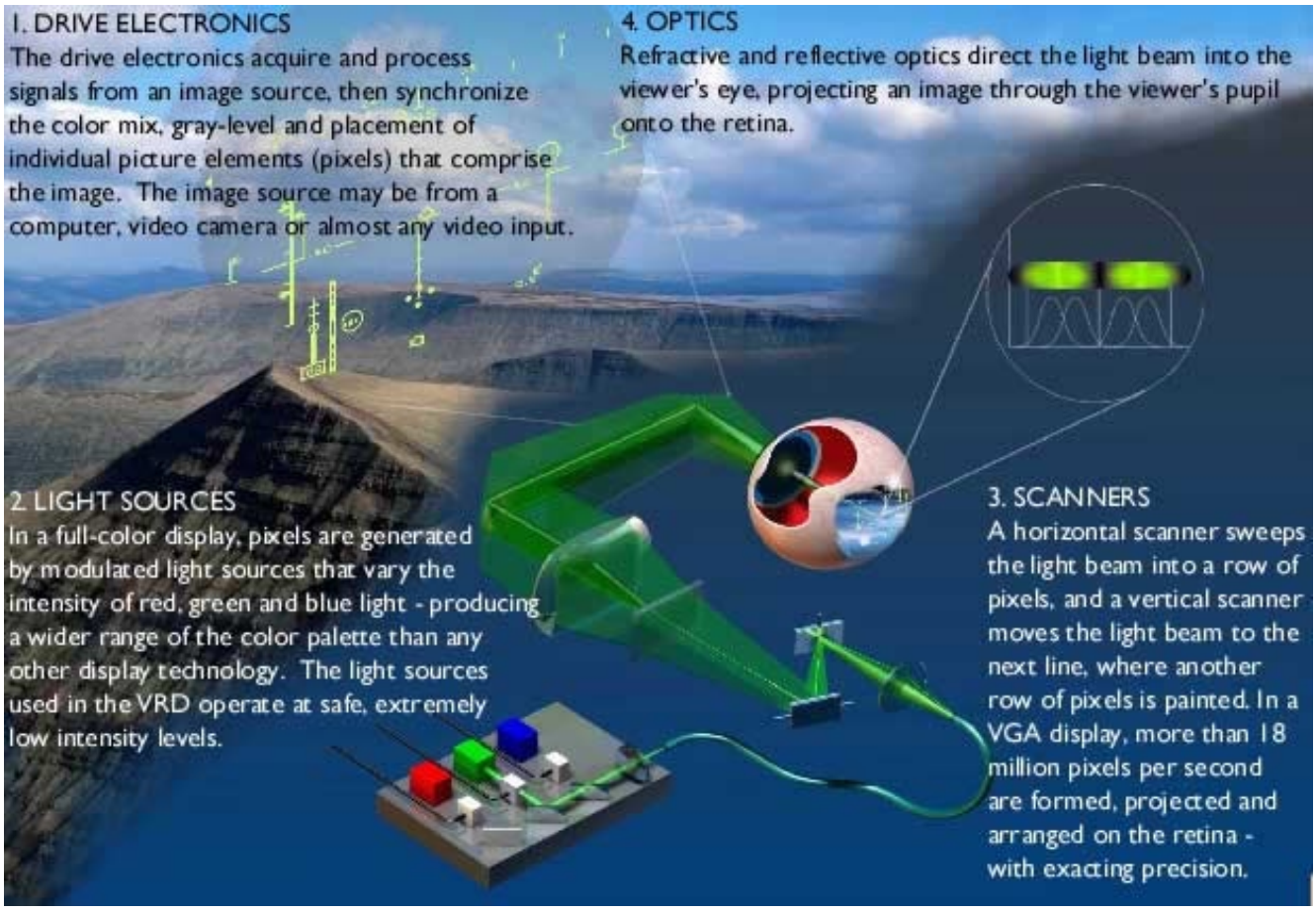


Figure 216.

Our development focuses on the raster method of scanning an image and allows the VRD to be driven by standard video sources. To draw the raster, a horizontal scanner moves the beam to draw a row of pixels. The vertical scanner then moves the beam to the next line where another row of pixels is drawn... After scanning, the optical beam must be properly projected into the eye. The goal is for the exit pupil of the VRD to be coplanar with the entrance pupil of the eye. The lens of the eye will then focus this collimated light beam on the retina to form a spot. The position on the retina where the eye focuses a spot is determined by the angle at which light enters the eye. This angle is determined by the scanners and is constantly varying in a raster pattern. The intensity of the focused spot is determined by the intensity modulation of the light beam. The intensity modulated moving spot focused on the retina forms an image. The final portion of the system is the drive electronics which must synchronize the scanners with the intensity modulators to form a stable image. For 3-D viewing an image will be projected into both of the user's eyes. Each image will be created from a slightly different view point to create a stereo pair. With the VRD, it is also possible to vary the focus of each pixel in the image such that a true 3-D image is created. Thus, the VRD has the ability to generate an inclusive, high resolution 3-D visual environment in a device the size of conventional eyeglasses.[589] And so by substituting the incoherent source of light with a coherent source as is done with the Retinal Laser Display we are literally intensifying our visual perception with the foundational light of the universe. In a similar way the source image is projected directly onto the retina instead of the back of the back of a screen. While in the Flat Panel Display pixels are projected from a highly integrated matrix of electronically controlled light valves or light-emitting elements, the VRD technology eliminates any screen outside of the eye and addresses the retina with a single stream of pixels.

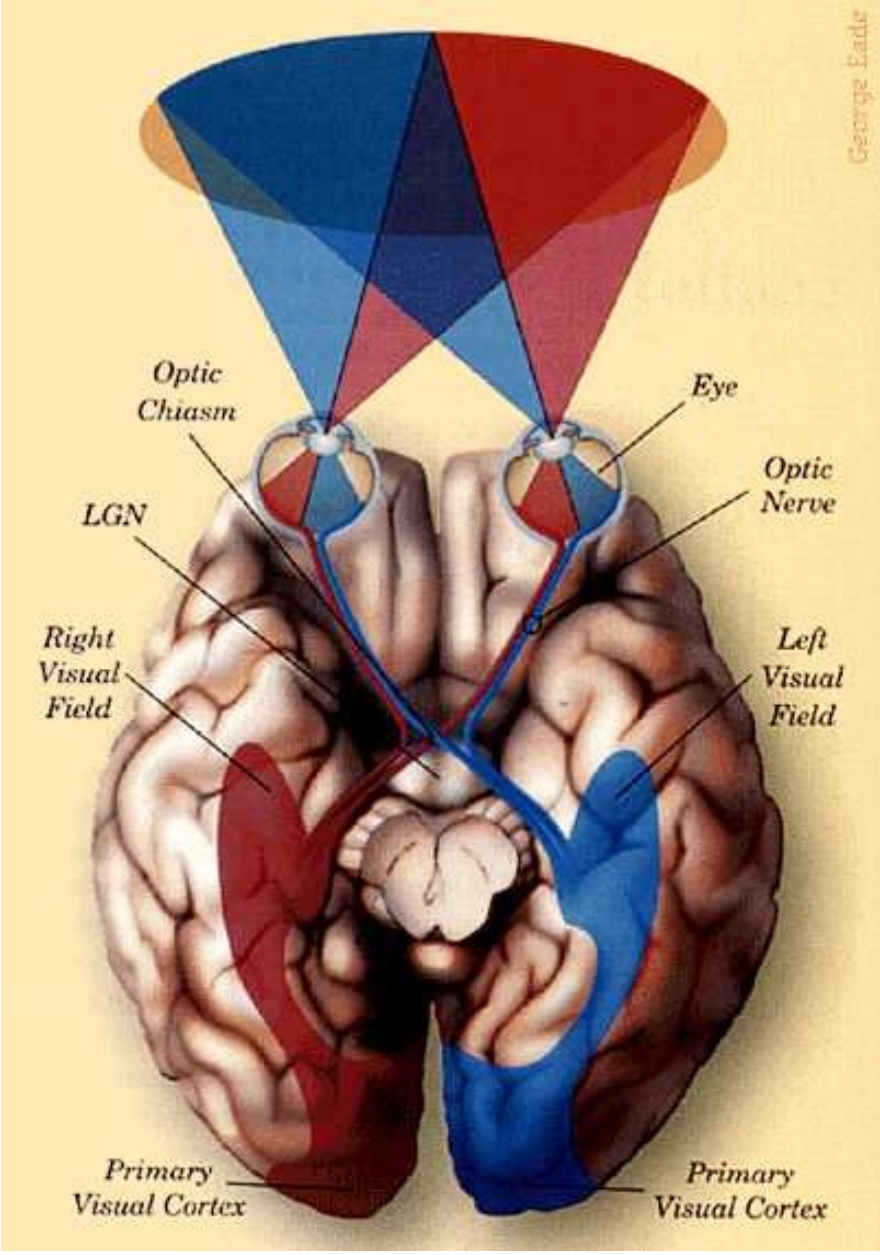


Figure 217.The two eyes provide slightly different views of the same scene. Information from the left visual field goes to the right side of the retina in both eyes. At the optic chiasm, half the nerve fibers from the left eye cross over to the right hemisphere and the rest stay uncrossed, so that all the information from the left visual field ends up in the right hemisphere. In this way, a given hemisphere gets information from the opposite half of the visual world but each hemisphere gets input from both eyes. Thus, the future VRD product must have stereoscopic capabilities.[590] Credit: courtesy of HITL.

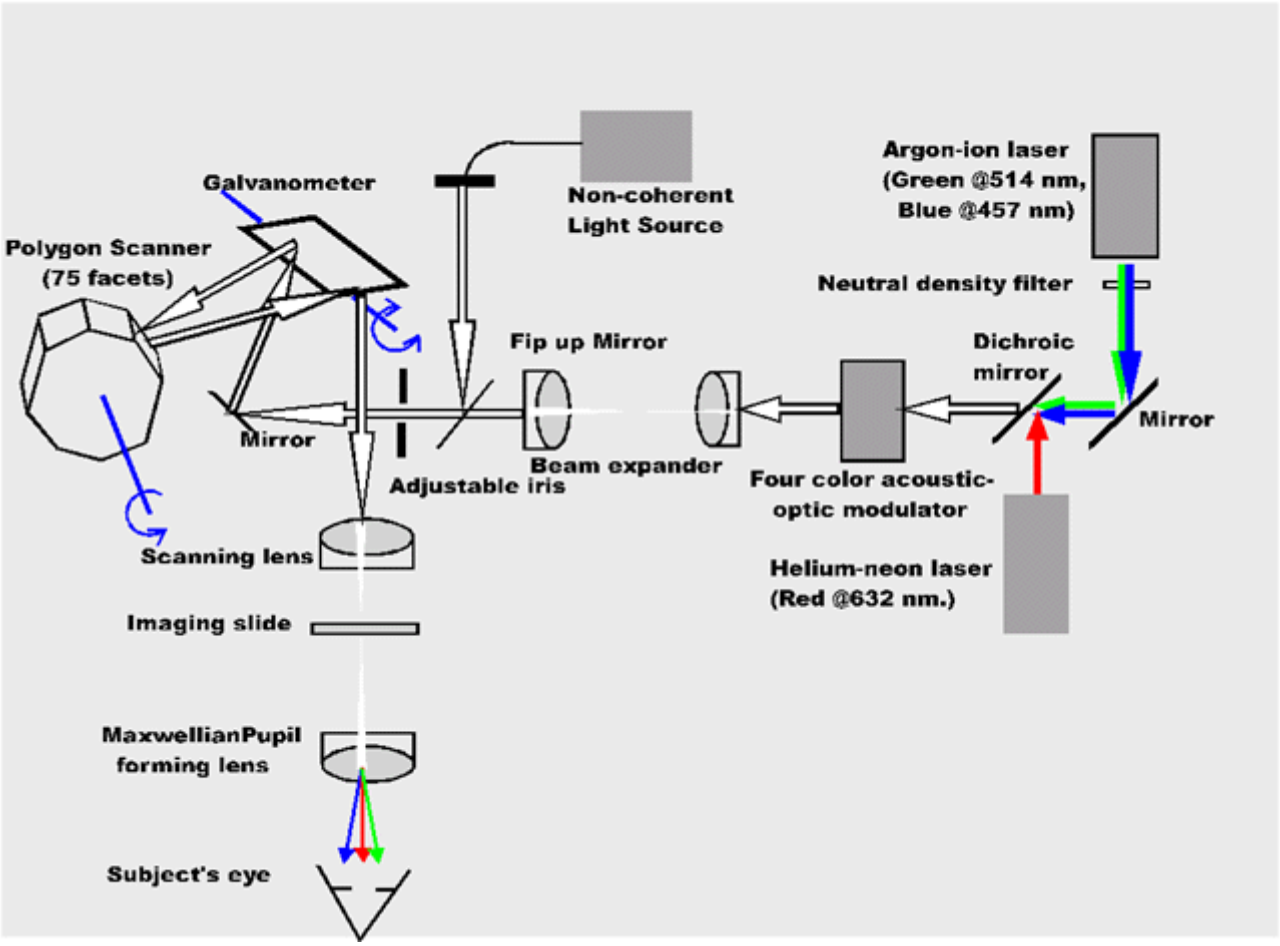


Figure 218. Future Virtual Retinal Display systems will be Microelectromechanical systems (MEMS-based) scanners. Edge-emitting, super-luminescent light-emitting diodes (SLEDs) and miniature diode lasers under development will allow direct light modulation. In conjunction with application-specific integrated-circuit technology, these devices will permit the direct fabrication of a VRD display engine incorporating the electronics, light sources, and scanning assembly, all in a compact, hand-held, battery-operated package. The ultimate goal for the retinal scanning technology is a lightweight eyewear package as above. The approach can also be adapted to image projection systems. The applications for VRD technology are varied591 head up displays (HUDs), color projections systems for entertainment or flight training simulators, etc. A key area for continued development is an image display system that can augment and enhance a person's task performance. [592] Credit: courtesy of HITL.[593]

Unlike CRT monitors, the VRD has no phosphorus persistence but, depends on the light-gathering properties of the photoreceptors and the temporal integration properties of the visual system. Therefore, the interactions between the VRD delivered light and the psychophysical image quality created by the brain are of extreme importance for future enhancements. As shown above, the source image is directed into the drive electronics device where the green, blue, and red light are modulated. Then each pixel passes through the horizontal and vertical scanners (one moves from left to right and the other from up to down) and produces a rasterized image onto the retina. In computer graphics, a raster graphics image or bitmap, is a data structure representing a generally rectangular grid of pixels, or points of color, viewable via a monitor, paper, or other display medium. Raster images are stored in image files with varying formats (see Comparison of graphics file formats). A bitmap corresponds bit-for-bit with an image displayed on a screen, generally in the same format used for storage in the display's video memory, or maybe as a device-independent bitmap. Bitmap is technically characterized by the width and height of the image in pixels and by the number of bits per pixel (a color depth, which determines the number of colors it can represent). The printing and prepress industries know raster graphics as contones (from "continuous tones") and refer to vector graphics as "line work". The word "raster" has its origins in the Latin rastrum (a rake), which is derived from radere (to scrape), and recalls metaphorically the systematic sampling of a grid-pattern of individual pixel-spaces with a view to representing an overall image. The retina has no persistence like phosphorus. Moreover, there is no flickering and the produced image is very bright with very high resolution. The time each pixel is projected onto the retina is very small (30-40ns). Furthermore, these devices consume very little amount of energy. They also provide a wider field of view. A very sophisticated representation of how the beam is projected through the pupil can be found in the HIT Lab of Washington University (VRD animations).

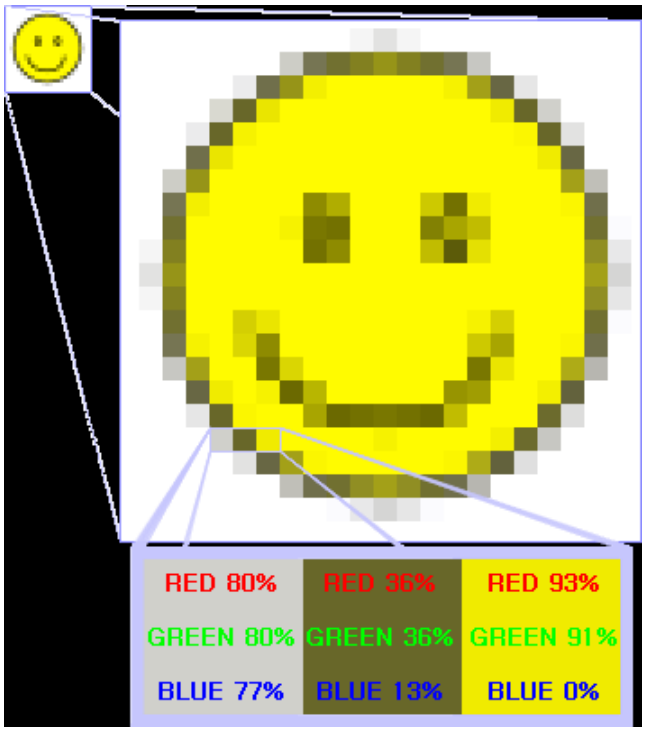


Figure 219. Imagine the smiley face in the top left corner as an RGB bitmap image. When zoomed in, it might look like the big smiley face to the right. Every square represents a pixel. Zooming in further, the individual pixels can be analyzed, with their colors constructed by adding the values for red, green and blue. Credit: courtesy of Wikipedia.

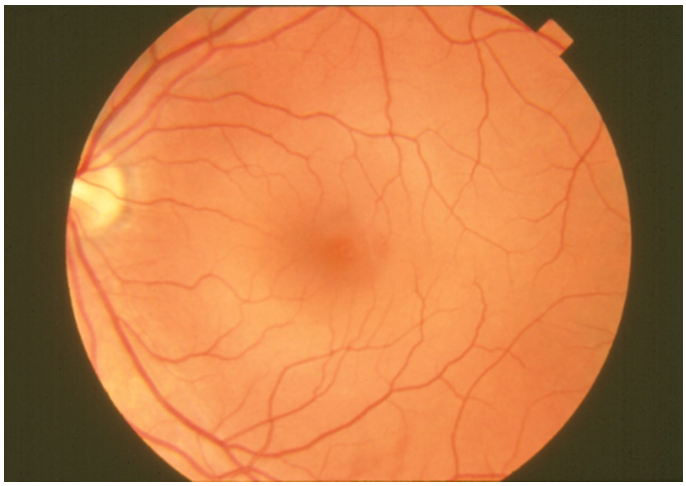
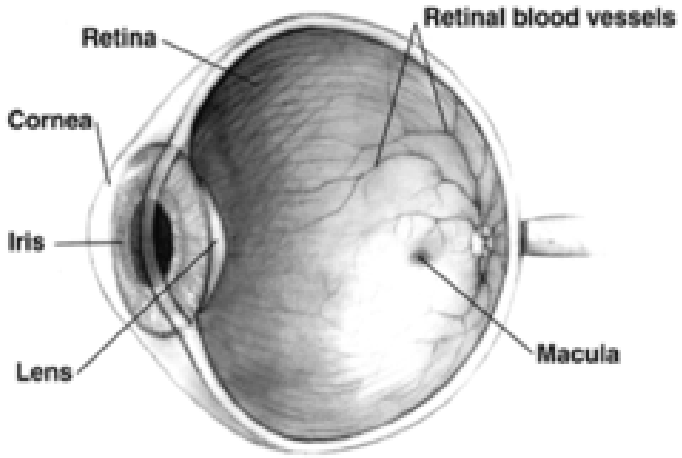


Figure 220. Retina Fundus photograph-normal retina Credit: National Eye Institute, National Institutes of HealthRef#: EDA06. The unique structure of the blood vessels in the retina has been used for biometric identification.

The retina is the light sensitive inner layer of the eye, which receives images formed by the lens and transmits them through the optic nerve to the brain. It is comparable to the film in a camera. In vertebrate embryonic development, the retina and the optic nerve originate as outgrowths of the developing brain. Hence, the retina is part of the central nervous system (CNS). It is the only part of the CNS that can be imaged directly.



,Figure 221. Right human eye cross-sectional view. Courtesy NIH National Eye Institute. Many animals have eyes different from the human eye.

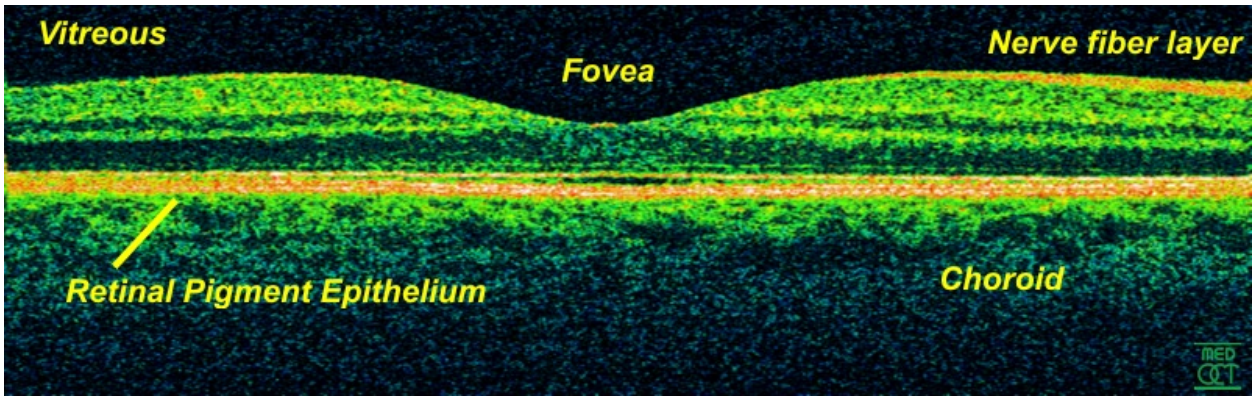


Figure 222. OCT scan of a retina at 800nm with an axial resolution of 3µm. A relatively new technology, now becoming widely available, is optical coherence tomography (OCT). This non-invasive technique allows one to obtain a 3D volumetric or high resolution cross-sectional tomogram of the retinal fine structure with histologic-quality. Credit; courtesy of Wikipedia.

The vertebrate retina contains photoreceptor cells (rods and cones) that respond to light; the resulting neural signals then undergo complex processing by other neurons of the retina. The retinal output takes the form of action potentials in retinal ganglion cells whose axons form the optic nerve. Several important features of visual perception can be traced to the retinal encoding and processing of light.

• A third category of photosensitive cells in the retina is not involved in vision. A small proportion of the ganglion cells, about 2% in humans, contain the pigment melanopsin and respond primarily to blue light, about 470 nm. The signals from these cells do not go through the optic nerve, and thus can function in many totally blind individuals. The information about light goes through the retinohypothalamic tract directly to the SCN (suprachiasmatic nucleus) and are necessary for the organism's adjustment of its circadian rhythms.

Anatomy of vertebrate retina

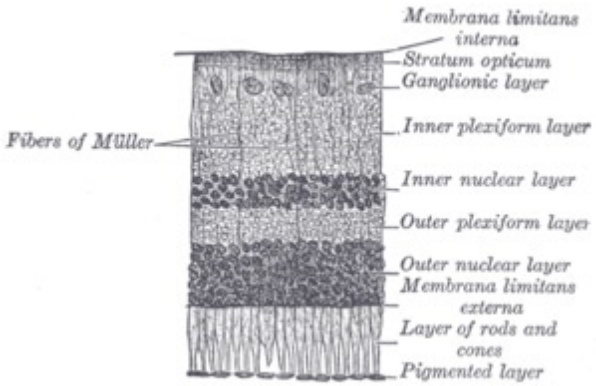


Figure 223. Section of retina.

The vertebrate retina has ten distinct layers.[1] From innermost to outermost, they include:

1. Inner limiting membrane - Müller cell footplates
2. Nerve fiber layer
3. Ganglion cell layer - Layer that contains nuclei of ganglion cells and gives rise to optic nerve fibers.
4. Inner plexiform layer
5. Inner nuclear layer
6. Outer plexiform layer - In the macular region, this is known as the Fiber layer of Henle.
7. Outer nuclear layer
8. External limiting membrane - Layer that separates the inner segment portions of the photoreceptors from their cell nuclei.
9. Photoreceptor layer - Rods / Cones
10. Retinal pigment epithelium

Physical structure of human retina

In adult humans the entire retina is 72% of a sphere about 22 mm in diameter. An area of the retina is the optic disc, sometimes known as “the blind spot” because it lacks photoreceptors. It appears as an oval white area of 3 mm². Temporal (in the direction of the temples) to this disc is the macula. At its center is the fovea, a pit that is most sensitive to light and is responsible for our sharp central vision. Human and non-human primates possess one fovea as opposed to certain bird species such as hawks who actually are bifoviate and dogs and cats who possess no fovea but a central band known as the visual streak. Around the fovea extends the central retina for about 6 mm and then the peripheral retina. The edge of the retina is defined by the ora serrata. The length from one ora to the other (or macula), the most sensitive area along the horizontal meridian is about 3.2 mm.

In section the retina is no more than 0.5 mm thick. It has three layers of nerve cells and two of synapses. The optic nerve carries the ganglion cell axons to the brain and the blood vessels that open into the retina. As a byproduct of evolution, the ganglion cells lie innermost in the retina while the photoreceptive cells lie outermost. Because of this arrangement, light must first pass through the thickness of the retina before reaching the rods and cones. However it does not pass through the epithelium or the choroid (both of which are opaque).

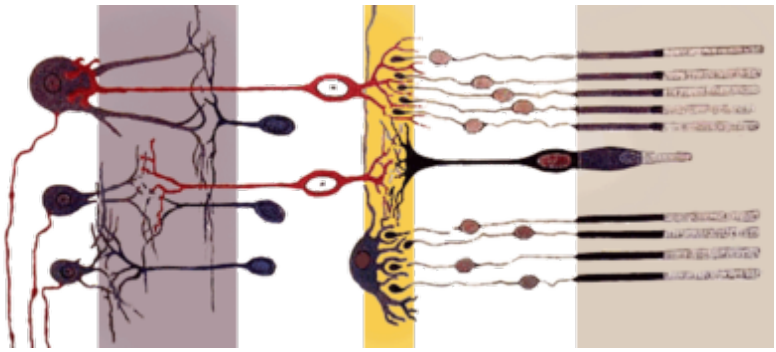


Figure 224. Retina's simplified axial organization. The retina is a stack of several neuronal layers. Light is concentrated from the eye and passes across these layers (from left to right) to hit the photoreceptors (right layer). This elicits chemical transformation mediating a propagation of signal to the bipolar and horizontal cells (middle yellow layer). The signal is then propagated to the amacrine and ganglion cells. These neurons ultimately may produce action potentials on their axons. This spatiotemporal pattern of spikes determines the raw input from the eyes to the brain. (Modified from a drawing by Ramón y Cajal.). Credit: courtesy of Wikipedia.

The white blood cells in the capillaries in front of the photoreceptors can be perceived as tiny bright moving dots when looking into blue light. This is known as the blue field entoptic phenomenon (or Scheerer's phenomenon).

Between the ganglion cell layer and the rods and cones there are two layers of neuropils where synaptic contacts are made. The neuropil layers are the outer plexiform layer and the inner plexiform layer. In the outer the rod and cones connect to the vertically running bipolar cells and the horizontally oriented horizontal cells connect to ganglion cells. The central retina is cone-dominated and the peripheral retina is rod-dominated. In total there are about seven million cones and a hundred million rods. At the centre of the macula is the foveal pit where the cones are smallest and in a hexagonal mosaic, the most efficient and highest density. Below the pit the other retina layers are displaced, before building up along the foveal slope until the rim of the fovea or parafovea which is the thickest portion of the retina. The macula has a yellow pigmentation from screening pigments and is known as the macula lutea.

Vertebrate and cephalopod retina differences

The vertebrate retina is inverted in the sense that the light sensing cells sit at the back side of the retina, so that light has to pass through a layer of neurons before it reaches the photoreceptors. By contrast, the cephalopod retina is everted: the photoreceptors are located at the front side of the retina, with processing neurons behind them. Because of this, cephalopods do not have a blind spot.

The cephalopod retina does not originate as an outgrowth of the brain, as the vertebrate one does. This shows that vertebrate and cephalopod eyes are not homologous but have evolved separately…

More specifically, in evolutionary biology, homology has come to mean any similarity between characters that is due to their shared ancestry. There are examples in different branches of biology. Anatomical structures that perform the same function in different biological species and evolved from the same structure in some ancestor species are homologous. In genetics, homology can be observed in DNA sequences that code for proteins (genes) and in noncoding DNA. For protein coding genes, one can compare translated amino-acid sequences of different genes. Sequence homology may also indicate common function. Homologous chromosomes are non-identical chromosomes that can pair (synapse) during meiosis, and are believed to share common ancestry. The word homologous derives from the ancient Greek ομολογειν, 'to agree'.[1]

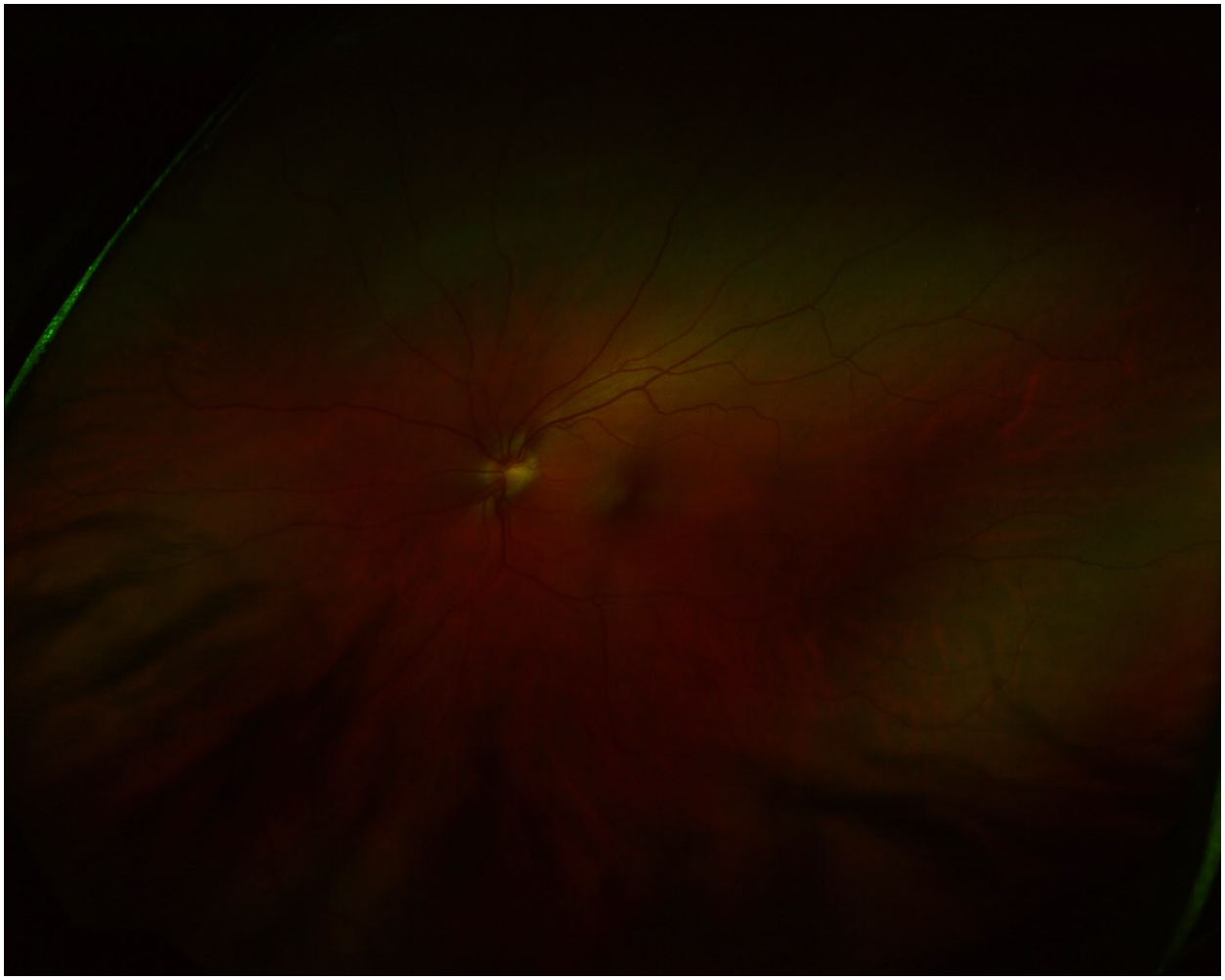


Figure 225. Scanning laser ophthalmoscopy is a method of examination of the eye. It uses the technique of confocal laser scanning microscopy for diagnostic imaging of retina or cornea of the human eye. It is helpful in the diagnosis of glaucoma, macular degeneration, and other retinal disorders.It has been combined with adaptive optics technology to provide sharper images of the retina.[1][2][2] Credit: courtesy of Wikipedia.

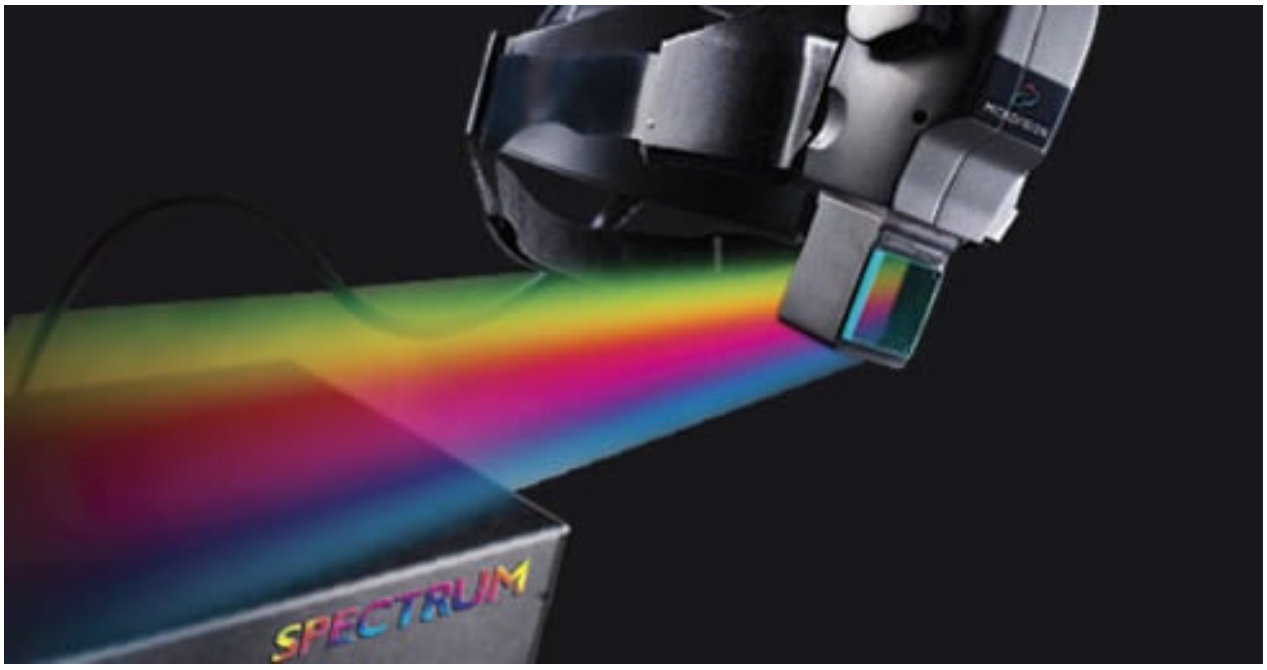


Figure 226. Credit: courtesy of Microvision.

Physiology

An image is produced by the "patterned excitation" of the retinal receptors, the cones and rods. The excitation is processed by the neuronal system and various parts of the brain working in parallel to form a representation of the external environment in the brain.

The cones respond to bright light and mediate high-resolution vision and color vision. The rods respond to dim light and mediate lower-resolution, black-and-white, night vision. It is a lack of cones sensitive to red, blue, or green light that causes individuals to have deficiencies in color vision or various kinds of color blindness. Humans and old world monkeys have three different types of cones (trichromatic vision) while other mammals lack cones with red sensitive pigment and therefore have poorer (dichromatic) color vision.

When light falls on a receptor it sends a proportional response synaptically to bipolar cells which in turn signal the retinal ganglion cells. The receptors are also 'cross-linked' by horizontal cells and amacrine cells, which modify the synaptic signal before the ganglion cells. Rod and cone signals are intermixed and combine, although rods are mostly active in very poorly lit conditions and saturate in broad daylight, while cones function in brighter lighting because they are not sensitive enough to work at very low light levels.

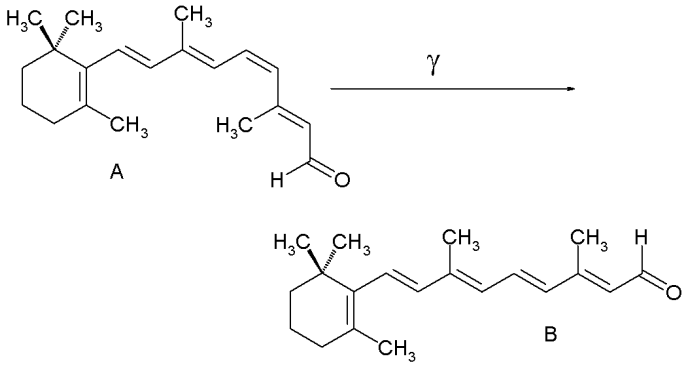


Figure 227. Retinal, technically called retinene1 or "retinaldehyde", is a light-sensitive retinene molecule found in the photoreceptor cells of the retina. Retinal is the fundamental chromophore involved in the transduction of light into visual signals, i.e. nerve impulses, in the visual system of the central nervous system. Retinal straightens after absorbing a photon γ of the correct wavelength. Photons can also be absorbed by nuclei, atoms or molecules, provoking transitions between their energy levels. A classic example is the molecular transition of retinal (C20H28O, Figure above), which is responsible for vision, as discovered in 1958 by Nobel laureate biochemist George Wald and co-workers. As shown here, the absorption provokes a cis-trans isomerization that, in combination with other such transitions, is transduced into nerve impulses. The absorption of photons can even break chemical bonds, as in the photodissociation of chlorine; this is the subject of photochemistry.[3]Credit: courtesy of Wikipedia.

Despite the fact that all are nerve cells, only the retinal ganglion cells and few amacrine cells create action potentials. In the photoreceptors, exposure to light hyperpolarizes the membrane in a series of graded shifts. The outer cell segment contains a photopigment. Inside the cell the normal levels of cGMP keeps the Na+ channel open and thus in the resting state the cell is depolarized. The photon causes the retinal bound to the receptor protein to isomerize to trans-retinal. This causes receptor to activate multiple G-proteins. This in turn causes the Ga-subunit of the protein to bind and degrade cGMP inside the cell which then cannot bind to the CNG Na+ channels. Thus the cell is hyperpolarized. The amount of neurotransmitter released is reduced in bright light and increases as light levels fall. The actual photopigment is bleached away in bright light and only replaced as a chemical process, so in a transition from bright light to darkness the eye can take up to thirty minutes to reach full sensitivity (see dark adaptation).

In the retinal ganglion cells there are two types of response, depending on the receptive field of the cell. The receptive fields of retinal ganglion cells comprise a central approximately circular area, where light has one effect on the firing of the cell, and an annular surround, where light has the opposite effect on the firing of the cell. In ON cells, an increment in light intensity in the centre of the receptive field causes the firing rate to increase. In OFF cells, it makes it decrease. In a linear model, this response profile is well described by a Difference of Gaussians and is the basis for edge detection algorithms. Beyond this simple difference ganglion cells are also differentiated by chromatic sensitivity and the type of spatial summation. Cells showing linear spatial summation are termed X cells (also called "parvocellular", "P", or "midget" ganglion cells), and those showing non-linear summation are Y cells (also called "magnocellular, "M", or "parasol" retinal ganglion cells), although the correspondence between X and Y cells (in the cat retina) and P and M cells (in the primate retina) is not as simple as it once seemed.

In the transfer of signal to the brain, the visual pathway, the retina is vertically divided in two, a temporal half and a nasal half. The axons from the nasal half cross the brain at the optic chiasma to join with axons from the temporal half of the other eye before passing into the lateral geniculate body.

Although there are more than 130 million retinal receptors, there are only approximately 1.2 million fibres (axons) in the optic nerve so a large amount of pre-processing is performed within the retina. The fovea produces the most accurate information. Despite occupying about 0.01% of the visual field (less than 2° of visual angle), about 10% of axons in the optic nerve are devoted to the fovea. The resolution limit of the fovea has been determined at around 10,000 points. The information capacity is estimated at 500,000 bits per second (for more information on bits, see information theory) without colour or around 600,000 bits per second including color.

Spatial Encoding

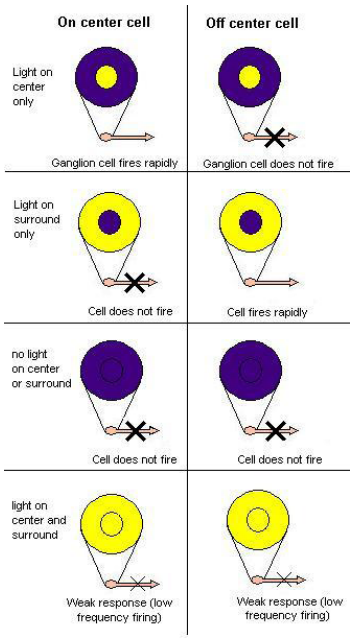


Figure 228. On-centers and off-centers of the retina

The retina, unlike a camera, does not simply relay a picture to the brain. The retina spatially encodes (compresses) the image to fit the limited capacity of the optic nerve. Compression is necessary because there are 100 times more Photoreceptor cells than ganglion cells as mentioned above. The retina does so by "decorrelating" the incoming images in a manner to be described below. These operations are carried out by the center surround structures as implemented by the bipolar and ganglion cells.

There are two types of center surround structures in the retina -- on-centers and off-centers. On-centers have a positively weighted center and a negatively weighted surround. Off-centers are just the opposite. Positive weighting is more commonly known as excitatory and negative weighting is more commonly known as inhibitory.

These center surround structures are not physical in the sense that you cannot see them by staining samples of tissue and examining the retina's anatomy. The center surround structures are logical (i.e., mathematically abstract) in the sense that they depend on the connection strengths between ganglion and bipolar cells. It is believed that the connection strengths between cells is caused by the number and types of ion channels embedded in the synapses between the ganglion and bipolar cells. Stephen Kuffler in the 1950s was the first person to begin to understand these centers surround structures in the retina of cats. See Receptive field for figures and more information on center surround structures. See chapter 3 of David Hubel's on-line book (listed below) for an excellent introduction.

The center surround structures are mathematically equivalent to the edge detection algorithms used by computer programmers to extract or enhance the edges in a digital photograph. Thus the retina performs operations on the image to enhance the edges of objects within its visual field. For example, in a picture of a dog, a cat and a car, it is the edges of these objects that contain the most information. In order for higher functions in the brain (or in a computer for that matter) to extract and classify objects such as a dog and a cat, the retina is the first step to separating out the various objects within the scene.

As an example, the following matrix is at the heart of the computer algorithm that implements edge detection. This matrix is the computer equivalent to the center surround structure. In this example, each box (element) within this matrix would be connected to one photoreceptor. The photoreceptor in the center is the current receptor being processed. The center photoreceptor is multiplied by the +1 weight factor. The surrounding photoreceptors are the "nearest neighbors" to the center and are multiplied by the -1/8 value. The sum of all nine of these elements is finally calculated. This summation is repeated for every photoreceptor in the image by shifting left to the end of a row and then down to the next line.

The total sum of this matrix is zero if all the inputs from the nine photoreceptors are the same value. The zero result indicates the image was uniform (non-changing) within this small patch. Negative or positive sums mean something was varying (changing) within this small patch of nine photoreceptors.

-1/8,-1/8,-1/8,-1/8,+1,-1/8,-1/8,-1/8,-1/8

Figure 229

The above matrix is only an approximation to what really happens inside the retina. First, the table is square while the center surround structures in the retina are circular. Second, neurons operate on spike trains traveling down nerve cell axons. Computers operate on a single constant number from each input pixel (the computer equivalent of a photoreceptor). Third, the retina performs all these calculations in parallel while the computer operates on each pixel one at a time. There are no repeated summations and shifting as there would be in a computer. Forth, the horizontal and amacrine cells play a significant role in this process but that is not represented here.

Here is an example of an input image and how edge detection would modify it.

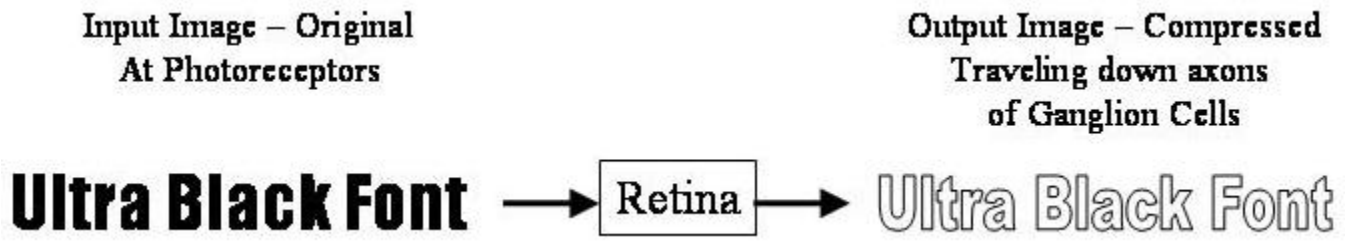


Figure 230.

Once the image is spatially encoded by the center surround structures, the signal is sent out the optical nerve (via the axons of the ganglion cells) through the optic chiasm to the LGN (lateral geniculate nucleus). The exact function of the LGN is unknown at this time. The output of the LGN is then sent to the back of the brain. Specifically the output of the LGN "radiates" out to the V1 Primary visual cortex.

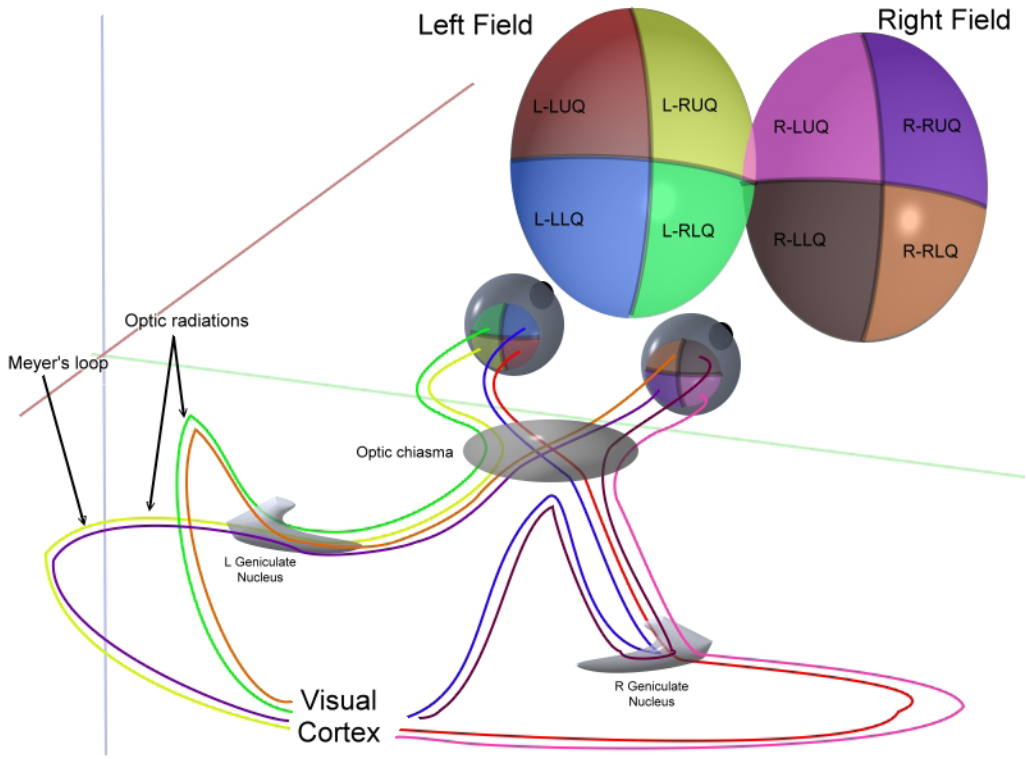


Figure 231. Simplified Signal Flow: Photoreceptors ==> Bipolar ==> Ganglion ==> Chiasm ==> LGN ==> V1 cortex. Credit: courtesy of Wikipedia.

The lateral geniculate nucleus (LGN) is the primary processing center for visual information received from the retina of the eye. The LGN is found inside the thalamus of the brain, and is thus part of the system. The LGN receives information directly from the ascending retinal ganglion cells via the optic nerve and from the reticular activating system. Neurons of the LGN send their axons through the the optic radiations, a pathway directly to the primary visual cortex, also known as the striate cortex. The primary visual cortex surrounds the calcarine fissure, a horizontal fissure in the medial and posterior occipital lobe.[1] In addition, the LGN receives many strong feedback connections from the primary visual cortex.[4]… The reticular activating system (or ARAS, for Ascending Reticular Activating System) is the name given to the part of the brain (the reticular formation and its connections) believed to be the center of arousal and motivation in mammals (including humans).

Functions

The activity of this system is crucial for maintaining the state of consciousness. It is situated at the core of the brain stem between the myelencephalon (medulla oblongata) and mesencephalon (midbrain). It is involved with the circadian rhythm. Damage can lead to permanent coma. It is thought to be the area affected by many psychotropic drugs. General anesthetics work through their effect on the reticular formation. Fibers from the reticular formation are also vital in controlling respiration, cardiac rhythms, and other essential functions. Although the functioning of this system is a prerequisite for consciousness to occur, it is generally assumed that this system's role is indirect and it does not, by itself, generate consciousness. Instead, its unique anatomical and physiological characteristics ensure that the thalamocortical system fire in such a way that is compatible with conscious experience. The reticular activating system controls our sexual patterns.[5]

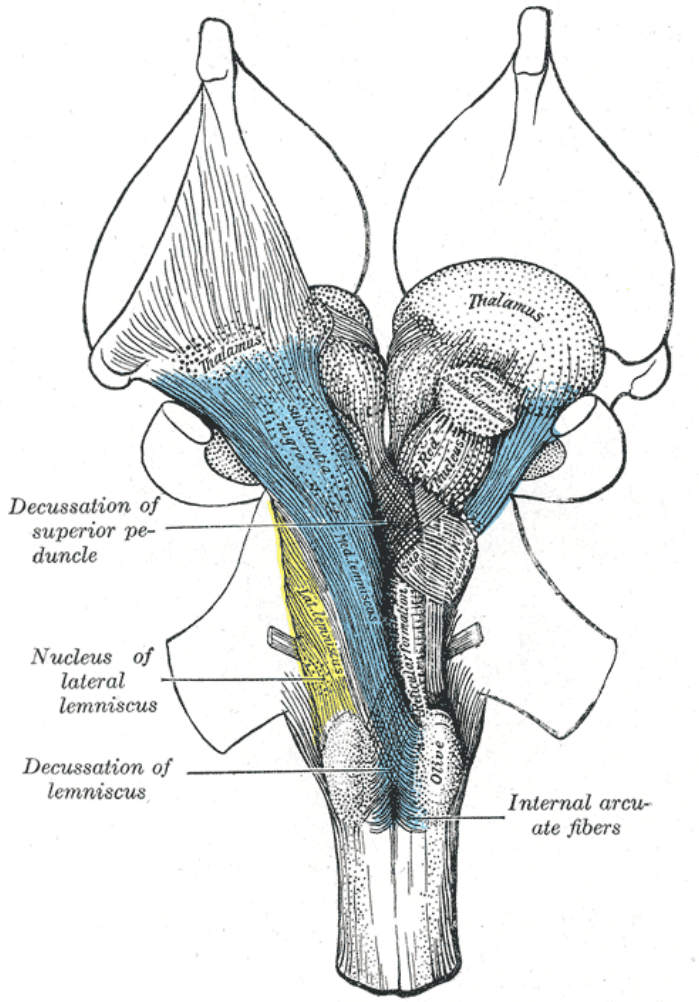


Figure 232. Deep dissection of brain-stem. Ventral view. (Reticular formation labeled near center.) Moving caudally from the rostral midbrain, at the site of the rostral pons and the midbrain, the medial RF becomes less prominent, and the lateral RF becomes more prominent. Existing on the sides of the medial reticular formation is its lateral cousin, which is particularly pronounced in the rostral medulla and caudal pons. Out from this area spring the cranial nerves, including the very important vagus nerve.[6] The Lateral RF is known for its ganglions and areas of interneurons around the cranial nerves, which serve to mediate their characteristic reflexes and functions. Credit: Courtesy of Wikipedia

Differences between Conscious and Non-conscious Processing: Why They Make a Difference

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The more reliable information accumulates about the functioning of the brain, the easier it becomes to formulate coherent and testable theories about the ways in which this functioning can be correlated with careful phenomenological accounts of the corresponding subjective events in consciousness. For example, ways to map patterns of electrical activity in specific areas of the brain are becoming increasingly sophisticated. EEG patterns, CT scans and other measures of neural activity in various parts of the brain have now been extensively correlated with conscious acts such as remembering (Damasio 1989; Damasio et al 1985); attention (Hernandez-Peon et al 1963; Posner and Rothbart 1992; Cohen et al 1988); the integration of sensory and memory mechanisms via frontal lobe activity (Nauta 1971); obsessional thought patterns (Gibson and Kennedy 1960); hysterical conditions (Flor-Henry 1979); feelings of elation and depression (Ahern and Schwartz 1985; Damasio and Van Hoesen 1983; Gainotti 1973); the activity of listening to music (Miller 1990: 79) -- which apparently involves very different brain areas for trained musicians (more left-lateralized); word recognition (Petersen et al 1989); language acquisition (Dore et al 1976); and many other such consciousness/brain-electrical correlations, some of which will be discussed later in this book.

In some instances, this information combined with phenomenological analysis facilitates reasonable inferences about the ways the physical and conscious processes are related. For instance, we know that, when a novel stimulus is presented, about a third of a second is required for increased electrical activity to be transferred from the primary projection area of the relevant sensory modality in the cortex (which receives direct sensory information from the outer nervous system but does not yet result in conscious awareness of a visual object) to the parietal and prefrontal areas whose activation does result in a conscious visual, auditory or tactile image of the object (Aurell 1983, 1984, 1989; Srebro 1985: 233-246; Runeson 1974: 14). Yet the primary sensory area and the relevant parietal area are almost immediately contiguous with each other. Why should a nervous impulse, which normally travels in the neighborhood of several hundred miles an hour (Restak 1984: 40), take a third of a second to travel a few millimeters? Obviously, it must be that much more complex processes are involved in activating conscious awareness of some perceptual content than a simple passive reception of a signal or stimulus in some particular part of the brain. More global processes must be involved before even the simplest possible conscious state, the having of a visual image, can be produced. But to understand what these more extended processes are requires putting together many bits of phenomenological and neurological information. This book will try to make a beginning in this direction.

One of the most important pieces of information relevant here is a phenomenological one: The selection of perceptual elements for conscious attention is partly a motivational process involving judgments about what is important for the organism's purposes. And the transmission of emotional purposes (which involve midbrain activity), into questions that conscious beings formulate for themselves in order to seek out relevant information in the environment, is a process which involves extensive prefrontal activity (Luria 1980, 1973; Damasio et al 1985, 1989; Eslinger and Damasio 1985; Nauta 1971). Thus we shall see that what goes on during that third of a second between primary projection area activation and parietal-prefrontal activation is a complex process involving emotion, motivation, and value judgments about what it is important to 'look for,' resulting in an efferent image formation which becomes a visual perception only when a match is finally found between the pattern of this efferent activity and the corresponding afferent input from the outer nervous system and the primary projection area. This means that the midbrain, the prefrontal cortex, and the parietal association areas are all involved in the production of the simplest possible conscious content. Besides the studies by Aurell, Runeson and Srebro just cited which show that passive stimulation of the 'visual cortex' does not result in perceptual consciousness unless there is frontal and parietal activity, there are similar findings with regard to the role of the reticular activating system in perception and the role of the frontal-limbic connection in recognizing the meaning of a remembered image (Ludwig 1977; Thompson 1975; Miller 1984, 1990; Gainotti et al 1993). According to Miller,

Conscious appreciation of a particular sensory impression . . . depends not just on the sensory pathways conveying that sensation, but also on the participation of a separate collateral system, the reticular activating system . . . responsible for literally 'directing attention' to incoming sensory information at different levels of processing.

Damage to this system produces a curious dissociative condition where the sensory areas of the brain process the information normally (as shown, for example, by the EEG), but the person remains subjectively unaware of the stimulus; it simply doesn't 'register' (Miller 1990: 173).

And, according to Damasio et al (1985: 252-259), unless the network of frontal-limbic connections is intact, images may produce a vague 'feeling of familiarity,' but their meaning and context cannot be recalled. It is also well known that Luria (1980) finds that physical disruption of almost any part of the brain (midbrain, frontal, parietal, temporal, etc.) interferes with memory function.

The need for all this interrelated frontal, limbic and parietal activity even for the simple perception of an object certainly dispels any notion that a given bit of cognitive information (say, the image of a horse, or the concept 'horse' occurring as the subject of a proposition) could correspond to a particular neuron or neural pathway, as some hypothesized cognitive architectures would require. It thus becomes increasingly obvious that for a cognitive theorist to posit models of information processing without considering what now can be known about neurophysiology and phenomenology is as though an architect were to design a bridge without attention to the tensile strength of the materials of which the bridge will be constructed, or as though a composer were to ignore the range limitations of the various instruments of the orchestra. Moreover, knowledge of the nature of an instrument not only limits what can be composed for the instrument; it also suggests musical possibilities for the instrument which one would not have thought of without some general understanding of the nature of the instrument on which the music is to be played. In the case of cognitive theory, we are looking for music which can be played on a conscious and organismic instrument.[7]

3.10: The VRD as a Laser Transducer of the Vector Potential into the Action potential of the Brain produces Laser Cognition Correction within the Bose-Einstein Structure of perception.

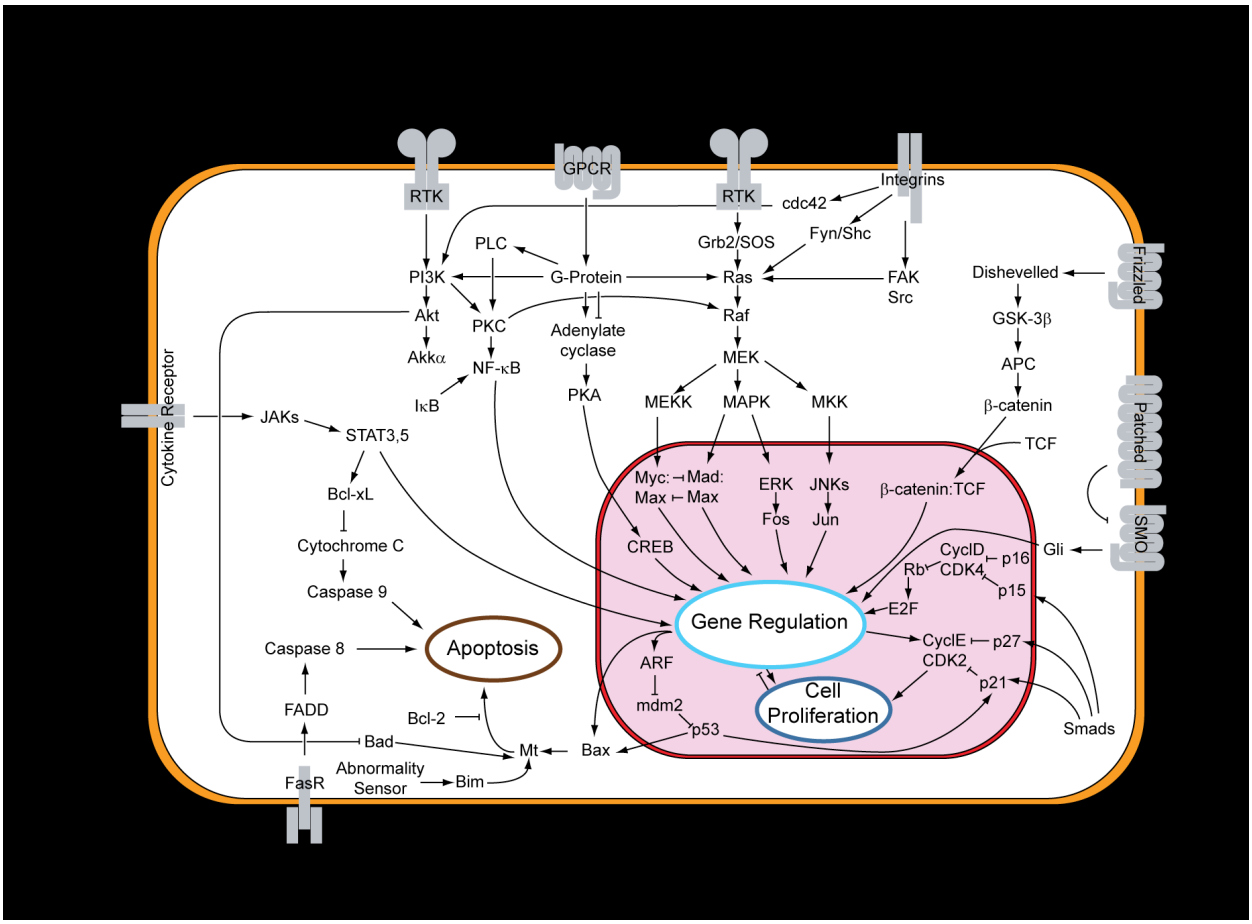


Figure 233. Overview of signal transduction pathways. In biology, signal transduction refers to any process by which a cell converts one kind of signal or stimulus into another. Most processes of signal transduction involve ordered sequences of biochemical reactions inside the cell, which are carried out by enzymes, activated by second messengers, resulting in a signal transduction pathway. Such processes are usually rapid, lasting on the order of milliseconds in the case of ion flux, or minutes for the activation of protein- and lipid-mediated kinase cascades, but some can take hours, and even days (as is the case with gene expression), to complete. The number of proteins and other molecules participating in the events involving signal transduction increases as the process emanates from the initial stimulus, resulting in a "signal cascade," beginning with a relatively small stimulus that elicits a large response. This is referred to as amplification of the signal. Credit Courtesy of Wikipedia.[8]

After discovering that the VRD augments the innate structure of our visual system and converts it into a laser transducer, I searched through a multiplicity of books, articles and the web for a similar description and found nothing, a question emerged. Why haven't the avant-garde writers and researchers seen the eye itself as a laser device? I believe that the act of naming things correctly plays a very important role in the proper identification of things. So the culprit is perhaps the name of the laser itself, which is in part a misnomer. This name hides the fact that the laser (light amplification by stimulated emission of radiation) is really a transducer; it generates a new kind of light from the old incoherent source and then amplifies it, so that what is amplified is the new coherent light. The same problem is found with the name of photons, which denote the idea of particles making discrete and disconnected jumps from one atomic level to another, when in reality we are dealing with a coherent electron wave function that is integrated, continuous and connected.[9] Anthony Siegman again clarifies for us how the photon picture hides the more complete perspective of the Laser process, but he also omits in his description that crucial biological idea of transduction. "Many descriptions of laser action use a photon picture... in which billiard-ball-like photons travel through the laser medium. Each photon, if it strikes a lower-level atom, is absorbed and causes the atom to make a "jump" upward. On the other hand, a photon, when it strikes an upper-level atom, causes that atom to drop down to the lower level, releasing another photon in the process. Although this picture is not exactly incorrect, we will avoid using it to describe laser amplification and oscillation, in order to focus from the beginning on the coherent nature of the stimulated transition process. The problem with the simple photon description... is that it leaves out and even hides the important wave aspect of

the laser interaction process... the whole stimulated transition process should be treated, not as a "photon process" but as a coherent wave process"…[10]

The universality of the coherence principle is clearly established by Prof. Paul Thagard in his seminal book; Coherence in Thought and Action. In this book he attempts "to construct a grand unified theory of human consciousness with its multifarious manifestations" across all fields of human cognition. This book is an essay on how people make sense of each other and the world they live in. Making sense is the activity of fitting something puzzling into a coherent pattern of mental representations that include concepts, beliefs, goals, and actions… Much of human cognition can be understood in terms of coherence as constraint satisfaction, and many of the central problems of philosophy can be given coherence-based solutions. Thagard shows how coherence can help to unify issues in psychology and philosophy, particularly when one is addressing questions of epistemology, metaphysics, ethics, politics, and aesthetics. He also shows how coherence can integrate cognition and emotion (2000 MIT Press). Thagard's coherence proposal is more specifically stated in the following. "In my new book, I propose that there are six main kinds of coherence: explanatory, deductive, conceptual, analogical, perceptual, and deliberative, each with its own array of elements and constraints. (3) Once these elements and constraints are specified, then the algorithms that solve the general coherence problem can be used to compute coherence in ways that apply to philosophical problems. Epistemic coherence is a combination of the first five kinds of coherence, and ethics involves deliberative coherence as well." There is also a seventh type which is physical according to the Laser theory.[11]

But since the central focus of this section is the awakening of visual coherence, (Laser Informed Eyes) let's see how Professor Thagard applies the universal formal principle of coherence to perception with Gestalt theory. For a great study of this theory see; Gestalt Psychology in German Culture, 18901967: Holism and the Quest for Objectivity (Cambridge Studies in the History of Psychology) by Mitchell G. Ash. This is the first full-length historical study of Gestalt psychology--an attempt to advance holistic thought within natural science. Holistic thought is often portrayed as a wooly-minded revolt against reason and modern science, but this is not so. On the basis of rigorous experimental research and scientific argument as well as on philosophical grounds, the Gestalt theorists Max Wertheimer, Wolfgang Köhler and Kurt Koffka opposed conceptions of science and mind that equated knowledge of nature with its effective manipulation and control. Instead, they attempted to establish dynamic principles of inherent, objective order and meaning in current language, principles of self-organization in human perception and thinking, in human and animal behavior, and in the physical world. The impact of their work ranged from cognitive science to theoretical biology and film theory. Based on exhaustive research in primary sources, including archival material cited here for the first time, this study illuminates the multiple social and intellectual contexts of Gestalt theory and analyzes the emergence, development and reception of its conceptual foundations and research programs from 1890 to 1967." Applying the gestalt view Dr. Thagard states that "visual perception begins with two-dimensional image arrays on the retina, but the visual interpretations that constitute sensory experience are much more complex than these arrays. How does the brain construct a coherent understanding of sensory inputs? In visual coherence, the elements are nonverbal representations of input images and full-blown visual interpretations, which fit together in accord with the following principles:

Principle V1: Symmetry. Visual coherence is a symmetric relation between a visual interpretation and a low-level representation of sensory input.

Principle V2: Interpretation. A visual interpretation coheres with a representation of sensory input if they are connected by perceptual principles such as proximity, similarity, and continuity.

Principle V3: Sensory priority. Sensory input representations are acceptable on their own.

Principle V4: Incompatibility. Incompatible visual interpretation is incoherent with each other.

Principle V5: Acceptance. The acceptability of a visual interpretation depends on its coherence with sensory inputs, other visual interpretations, and background knowledge.

Image arrays on the retina are caused by physical processes not subject to cognitive control, so we can take them as given (V3). But considerable processing begins even at the retinal level, and many layers of visual processing occur before a person has a perceptual experience. The sensory inputs may be given, but sensory experience certainly is not. Sensory inputs may fit with multiple possible visual interpretations that are incompatible with each other and are therefore incoherent and the source of negative constraints (V4).

Thus the Gestalt principles (proximity, similarity, continuity, closure, size constancy, texture gradients, motion parallax, and retinal disparity) and other assumptions built into the human visual system establish coherence relations that provide positive constraints linking visual interpretations with sensory input. Negative constraints arise between incompatible visual interpretations, such as the two way of seeing the Necker cube (figure 234). Our overall visual experience arises from accepting the visual interpretation that satisfies the most positive and negative constraints. Coherence thus produces our visual knowledge, just as it establishes our explanatory and deductive knowledge. (p. 58-60).

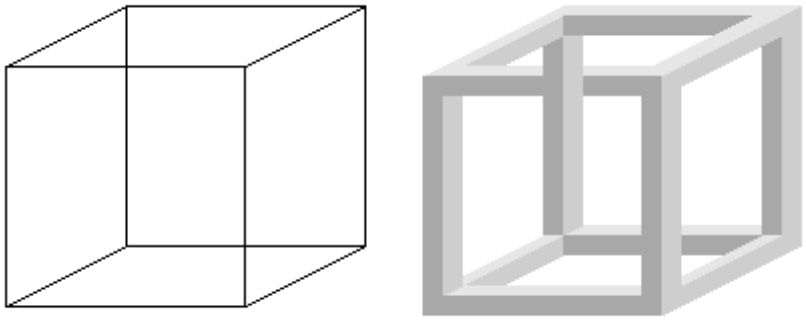


Figure 234. Necker cube on the left, impossible cube on the right. The Necker cube is an optical illusion first published in 1832 by Swiss crystallographer Louis Albert Neck. Credit: courtesy of Wikipedia.[12]

Coherence

Paul Thagard has proposed that many cognitive functions, including perception, analogy, explanation, decision-making, planning etc., can be understood as a form of (maximum) coherence computation. Thagard (together with Karsten Verbeurgt) put forth a particular formalization of the concept of coherence as a constraint satisfaction problem. The model posits that coherence operates over a set of representational elements (e.g., propositions, images, etc.) which can either fit together (cohere) or resist fitting together (incohere). If two elements p and q cohere they are connected by a positive constraint $(p,q) \in C^+$, and if two elements p and q incohere they are connected by a negative constraint $(p,q) \in C^-$. Furthermore, constraints are weighted, i.e., for each constraint $(p,q) \in C^+ \cup C^-$ there is a positive weight w (p,q).

According to Thagard, coherence maximization involves the partitioning of elements into accepted (A) and rejected (R) elements in such a way that maximum number (or maximum weight) of constraints is satisfied. Here a positive constraint (p,q) is said to be satisfied if either both p and q are accepted ($p,q \in A$) or both p and q are rejected ($p,q \in R$). A negative constraint (p,q) is satisfied if one element is accepted(say $p \in A$), and the other rejected ($q \in R$).[13]

Microvision's Retinal Laser Display not only projects the universal formal principle of coherence into our laser-eyes, it also converts our eyes into a multidimensional visual display. And it also converts the regular characters of the alphabet into radiant laser fonts. The conversion of the alphanumeric characters of the verbal language into laser fonts fulfilled the idea of creating the LaserEmpowered Book. I had conceived this idea on April-16-2000 as a way of reading in the radiant format. I had originally bought the Pangolin Laser Designer program with a laser projector to accomplish this project. But with Microvision's VRD the Radiant words are now projected directly into the retina and thereby into the cognitive faculty of the brain. This in my view is the ultimate transition to that universal visual language of lasers envisioned by Dr, Nolte. And by connecting our Laser Informed Eyes to the all-optical Internet we are literally creating a coherent global brain.

Today with the projection of the Laser Informed Book unto our cognitive system our brain is placed respectively in stimulated absorption (12) and emission (21) of Einstein's (1221) radiant thoughts, where we are driven by and coherent with his original vision. The coherent experience of his radiant thoughts empowers us to reproduce and amplified his original vision, given by his laser message. Now we understand Einstein's source of mental power. When he concentrated his effort in order to know how the laser works via his examination of Bohr's incoherent radiation (21) and absorption (12) model, not only did he absorbed the coherent light source (12) via his conception of the Laser theory, but he also enabled all of humanity to experience the coherent radiation (21). And by incorporating the laser directly into the eye, Einstein's radiant thoughts will clear our eyes so that our whole brain is filled with his coherent light. Coherency is to rational consciousness what decoherence is to the irrational unconsciousness. there is approximately, 2% coherent light and 98% incoherent light operating in this world. See Lasers: The Light Wave of the Future by Allan Maurer for illustrations of this disproportionate distribution of light on our planet.[14] This disproportionate distribution of light is exactly reflected in the percentage of conscious access to our brain's potential. Even though we use 100% our brains, we have 2% coherent conscious processing of information and 98% decoherence or unconscious sorting of useless and useful information. (See George Lakoff's cognitive ideas @ Wikipedia and his books for further development of this disproportionate ratio of conscious to unconscious processing)

It is commonly known that about 80% of all information that enters our brain comes through the retina and visual cortex. The rest comes through our other senses of hearing, touch, smell, and taste. (See: Visual Intelligence: How We Create What We See by Donald D. Hoffman). Because of this disproportionate exposure to the incoherent light, the majority of the information we process through the retina and brain is therefore incoherent in nature. The retina, an extension of the neo-cortex, is essentially a light transducer, or frequency analyzer. Given the incoherent nature of the light sources in the world, this places a huge burden on the brain to interpret the multitude of frequencies and wavelengths of light that we are bombarded with each second, so as to create meaningful images. Our theory now became very specific and quantifiable as Maiman suggested. Now we can say that consciousness is proportional to coherency by a factor of 2%, while unconsciousness is proportional to decoherence by a factor of 98%. In other words coherency is to

consciousness what decoherence is to unconsciousness. Achieving optimal cognitive performance will therefore depend on increasing coherence in the brain. Optimal cognitive performance of the brain has been the subject of much research over the last century. Biofeedback scientists have developed ways of measuring the electrical characteristics of brainwave activity (EEG), while others theorize at the cellular level. Most recently, there has been an increasing interest in what is called a "quantum" or "coherent" state of the brain, which is possibly responsible for the highest levels of cognitive performance.

The main problem that the coherent quantum brain has to overcome is the phenomena of decoherence in the brain. Incoherent signals weaken signal transmission between neurons. This is the source of mediocre brain performance. Incoherent light is the source of brain decoherence which is defined as the rapid macroscopic destruction of the coherent quantum state. "Decoherence is not a given intrinsic property of nature but the dynamic effect of incoherent light sources or heat produced through friction, a few electrons or a few traveling vibrations (Phonons)." [15] Decoherence is the incoherent quantum aggregates responsible for preventing the coherent light from living fully in our brains. This is the source that keeps us ignorant of our coherent potential; literally it has the unconscious brain enslaved to misinformation and misinterpretation. I found the solution to decoherence in our brains with the Microvision approach to the intensification of the retina with coherent light. Because laser light is the supreme informant, we can transmit to the brain the entire library of congress with wave division multiplexing in seconds. And have the brain control or guide this information with the non-linear optics of the VRD. This powerful communication capability makes the VRD the keystone technology for unleashing and liberating the full potential of the brain. The coherent signal strengthens the brain and shields the information from being lost. It vitalizes the neuron connections thereby enhancing signal transmission, which is the source for optimal cognitive performance. Since the retina is truly a Neural Network that has massively parallel processing capacity, it is the main avenue to access the brain. "A recent University of Pennsylvania study calculated that the approximate bandwidth of human retinas is 8.75 megabits per second, whereas a guinea pig retinas transfer at 875 kilobits." [2][16]

The visual intelligence of pattern recognition, association and abstract classification is also improved because the cognitive faculty is able to fully concentrate on the stream of data continuously. And so, by placing the brain in stimulated absorption of the coherent signal it is truly enhanced by the parallel advantage of the laser light image. This capability empowers us with what Einstein once said that the only talent that separated him from the majority of mankind was his ability to concentrate on an idea for a prolonged period of time. Dr. Win Wenger, in his book "The Einstein Factor", presents clear evidence that when the brain achieves a "flow state" (figure 237),[17] there exists a level of coherent brainwave activity. It's in this "flow" state that people have been known to demonstrate peak mental and physical performance. For example, this is precisely the state of mind to which Dr. Wenger attributes the highest achievements of gifted scientists like Einstein (on whom the book is based) and champion athletes. Furthermore, he believes that achieving this state of consciousness is possible via his proven method for increasing intelligence, comprehension, and accelerated learning ability.

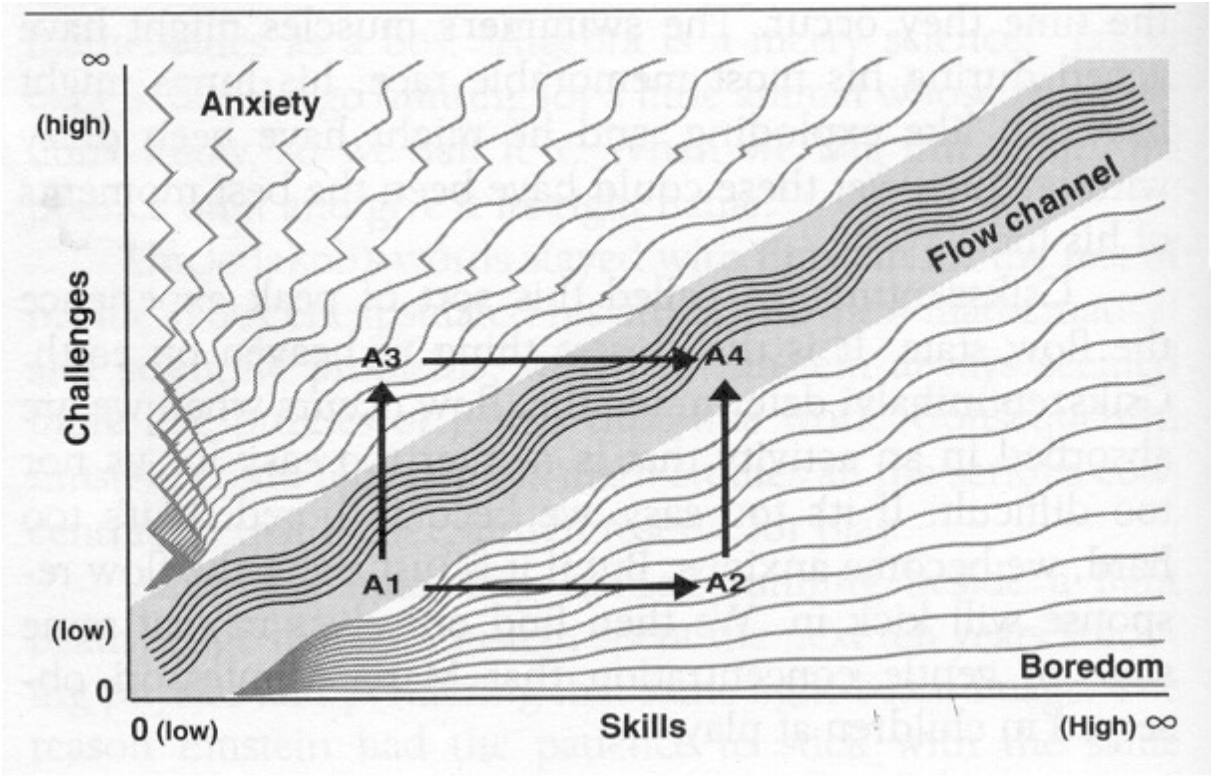
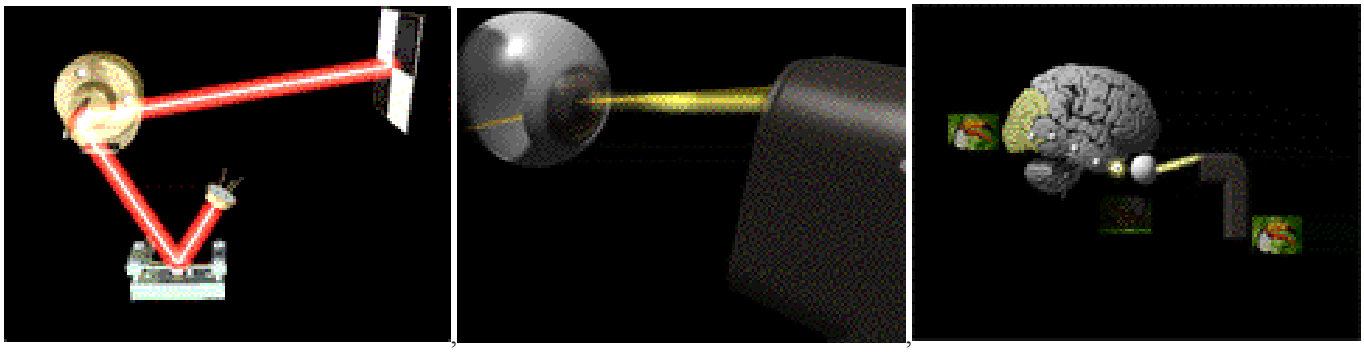


Figure 235. "Normal light is incoherent. The light waves are random wavelengths and out of phase. Laser light is coherent. All waves oscillate in phase. Scientists have discovered that brain waves, too, achieve laser-like coherence, especially when we experience sudden creative insights."[18] Credit: courtesy of the Einstein Factor by Dr. Wenger.

Dr. Wenger is a pioneer in the areas of creativity, accelerated learning, and mind development, with 48 published books to his credit. He refers to the "flow states" as a "coherent" state because of the similarity of brainwave patterns to that of a coherent light source. The challenge, however, is to find out how the brain achieves this optimal state consistently, and what triggers the production of coherent brainwave activity. A number of theories exist to explain this phenomenon. After years of research, the Laser information group has formulated a theory that suggests a direct connection between the coherent state of the brain and the light entering the brain through the retina and visual cortex. More specifically, we believe that coherent laser light can cause the brain to enter that "flow state" of optimal cognitive performance. This alone, could have a direct impact on improving a person's comprehension, understanding, memory, retention, assimilation, and other critical brain functions tied to the learning process.

I believe that stimulating our Laser Informed Eyes with Microvision's retinal laser display will become the preferred and most efficient way of maximizing the input, comprehension, retention, assimilation, and subsequent use of information. "Institutions of learning around the world will benefit from this technology. Individuals seeking the best possible way to achieve optimal cognitive performance will adopt the technology."[19] In a 2004 automotive white paper Microvision substantiated the laser informed idea about learning with the VRD. "Rethinking On-the-Job Training. The Nomad Expert Technician System has consistently shown the ability to improve the performance of novice technicians to approach the performance of master technicians by providing step-by-step instructions as each task is performed. Perhaps the most significant finding was during a test at an emergency vehicle maintenance facility where not only were novice times dramatically improved with head up, hands free access to instructions as they worked (up to 69% faster), but the actual improved time was within seconds of the improved time for the "expert" mechanics. In effect both were trained on the job, at point of task to achieve equal performance



, MRS & Galvo Scan, Eye Scan, Brain Scan

Figure 236. These three animations show how the Virtual Retinal Display (VRD) scans laser beams into the eye to create bright high-resolution images. Pick "MRS & Galvo Scan" to begin a guided tour. Credit: courtesy of HITL.

The learning curve virtually disappeared with the Nomad Expert Technician Package, but the added advantage of augmented-vision-based training and data access is the ability to effectively update the knowledge base of an entire field force by simply updating the content of a wireless network or Internet server... The answer and benefit for the industry is clear: Augmented vision and a wireless information tool can flatten the learning curve and enable workers to perform their task faster, better and safer."[20] The VRD can also serves as a platform to what David D. Nolte calls "the control of light by Light," which is also the foundation of "a new kind of intelligence or the intelligence of light."[21] This laser intelligence is holographic, meaning that it is transmitted via the parallel advantage of laser Light in dynamic holograms. Continuous real-time holography, called dynamic holography, is performed using nonlinear optical crystals," or laser diodes.[22]

Dynamic holography

There exist also holographic materials which don't need the developing process and can record a hologram in a very short time. This allows you to use holography to perform some simple operations in an all-optical way. Examples of applications of such real-time holograms include phase-conjugate mirrors ("time-reversal" of light), optical cache memories, image processing (pattern recognition of time-varying images), and optical computing. The amount of processed information can be very high (terabit/s), since the operation is performed in parallel on a whole image. This compensates the fact that the recording time, which is in the order of a μs, is still very long compared to the processing time of an electronic computer. The optical processing performed by a dynamic hologram is also much less flexible than electronic processing. On one side one has to perform the operation always on the whole image, and on the other side the operation a hologram can perform is basically either a multiplication or a phase conjugation. But remember that in optics, addition and Fourier transform are already easily performed in linear materials, the second simply by a lens. This enables some applications like a device that compares images in an optical way[7]

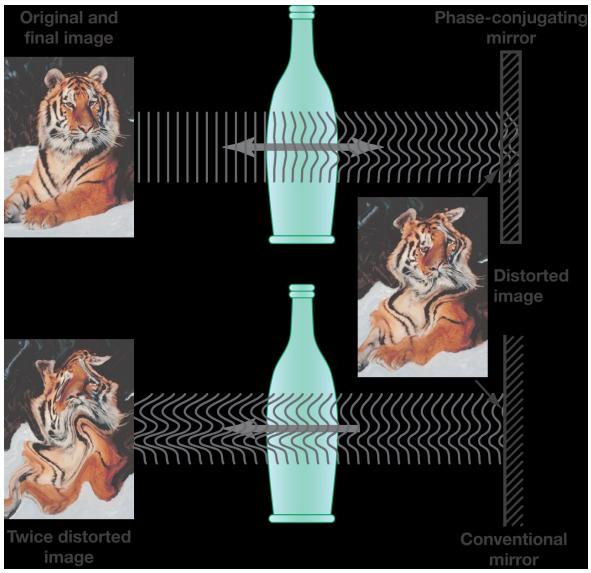


Figure 237. The wavefronts of a phase-conjugated image are reversed (conjugated) respect to their propagation direction. The deviations induced by an aberrating element (bottle) are thus eliminated when passed a second time. The image reflected by a normal mirror is aberrated even more when it passes through the bottle a second time. --Danh 18:32, 25 May 2005 (UTC)[23] Credit: courtesy of Wikipedia.

The search for novel nonlinear optical materials for dynamic holography is an active area of research. The most common materials are photorefractive crystals, but also in semiconductors or semiconductor heterostructures (such as quantum wells), atomic vapors and gases, plasmas and even liquids it was possible to generate holograms. A particularly promising application is optical phase conjugation. It allows the removal of the wavefront distortions a light beam receives when passing through an aberrating medium, by sending it back through the same aberrating medium with a conjugated phase. This is useful for example in free-space optical communications to compensate for atmospheric turbulence (the phenomenon that gives rise to the twinkling of starlight).

According to Gerald C. Huth, PhD, optical phase conjugation or time reversed light is directly involved in the retina. "I THINK IMPORTANT - I have proposed under the link "Additional Thoughts...." that a recently discovered phenomenon in laser physics - "time reversal and optical phase conjugation" may be involved in light interaction with the retina. In this process light waves are precisely redirected back along the exactly same path after being reflected from the phase conjugate "mirror". The retina as I view it appears to have exactly the properties of a phase conjugate mirror. Any such "redirection" only becomes apparent with the invocation of antenna behavior and the capability for encoding light intensity and phase which is the fundamental premise of this model."[24]

For the Laser Informed Learner, nonlinear optics allows lasers to be both "masters and servant of information." According to Prof. Nolte, "Optical fibers are excellent media in which to have light controlling light through optical nonlinearities. Even though . . . the virtues of fiber linearity, which allow multiple signals, as in time division multiplexing (TDM) and wave division multiplexing (WDM), to travel down the same fiber without affecting each other. This apparent paradox is resolved by considering the dividing line between linear optics and nonlinear optics. The essence of nonlinearities is that they depend on intensity as well as the frequency and coherence of the light. If intensities are small, then nonlinearities do not hamper the signal propagation. . . . On the other hand, if high intensities are used, and if individual signals share coherence, then indeed one propagating signal will affect another. This type of interaction forms the basis of the control of light by light inside fibers."[25] This nonlinear intelligent principle of lasers is the fundamental key that will guide our coherent minds to the creation and sharing of that vast library of knowledge and wisdom now available to all on the Lambdasphere. The Lambdasphere in this radiant sense emerges as the ultimate architectural model for the Internet. With the advent of the book, Mind at Light Speed, the Lambdasphere can now be fully translated and implemented as laser intelligence modeling for the new photonic power architecture of the Internet.

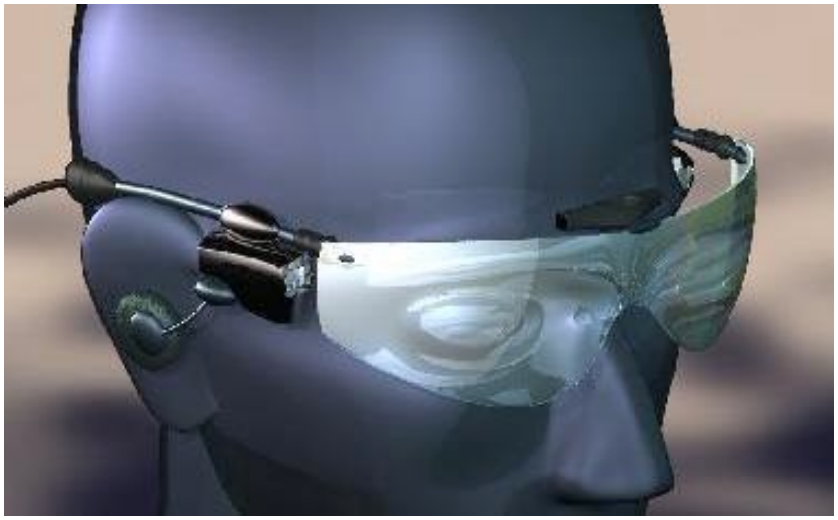


Figure 238. Microvision's VRD is a new display technology that scans modulated low energy laser light directly onto the viewer's retina to create a perception of a virtual image. Einstein's visual conception of the laser is now our perception. Credit: courtesy of Microvision.[26]

What is visual perception?[27] Light transduced by the retina into bio-electro-chemical codes and its interpretation by the cognitive faculty in the visual cortex is perception. It is the light that allows us to perceive. Light is the supreme informant of nature. Light is the ultimate carrier of information and intelligence. 80% of all the information that we receive from the world comes through the light in our eyes and the brain processes and perceives it. What the brain is processing is the light signal itself. What we perceive is an image created by electromagnetic signals, but we don't notice them, because we are immersed in the signals, and all we see is objects and symbols about objects. What we see is only what the light signals allows us to see or what the light illuminates externally and internally. Now, if the light source that you use to see is incoherent, diffused and disconnected what happens to your perception? Your perception is weakened by that incoherent source because the brain has to do a lot of work in correcting the distorted source in order to give us a coherent picture of the world. As Mead pointed out, this is "the brain's ability to extract meaningful signals from a large amount of useless information."[28] So the brain has to reverse the incoherent process by focusing and ordering the disconnected light source for a correct interpretation to take place. And in that process of interpretation, what happens? We get some things right but we also fall prey to deception, confusion and miss-interpretation, because the signals are distributed differently in people's minds and because you lose a lot of information in the transduction process. Why does a simple message become distorted and interpreted in so many different ways? Because under the influence of the disconnected diffusion of the incoherent light sources, like sunlight, moonlight, or incandescent bulb etc. along with its randomness and disordered waves or noise, the human brain is led to confusion and to a different conclusion.

On the contrary, what is the nature of my perception when the light source is coherent, connected, harmonic, focused, and pure, as in the laser? The message will be transmitted accordingly. The source of visual perception is the light, whether it is coherent or incoherent. Therefore, the kind of light one chooses will make the crucial difference in one's perception. I have chosen the coherent light source to complete our reading, living and understanding of nature. Because I truly believe that our perception is weakened by the incoherent source of light. We've been suffering under this light unconsciously, now thanks to Einstein's brilliant idea of the laser we can liberate ourselves. What Einstein uncovered in truth was the foundation light source of nature, before and after the thermodynamic corruption sets in. This is the true secret of the Laser's power. We want to empower our cognitive ability with this precious light so that we can upgrade our perceptual capacity. Only with the purity of the coherent light source will we be able to understand and thereby live the rational truth of our being. Otherwise the authentic perception of being is distorted and lost because a certain portion of the incoherent source of light is converted to decoherence in the visual cortex. This is the root cause of the diffusion of quantum interpretation that has divided the scientific consensus in the United States and the world over. We want to access the coherent light source itself, so that it would intensify the cognitive faculties and with this augmented vision to penetrate the true meaning of the reality of life. With this symmetric light source we can assimilate information more quickly and effectively.

What is the relevance of the light source in our perception? It took me a long time to realize this, because I was studying it from the philosophical and mathematical side without the benefit of the quantum science of Light known as Collective Electrodynamics (CED). It just didn't enter my range of thinking; I was basically blind—as Einstein would say—until the year 2000 when I avidly read Collective Electrodynamics by Carver Mead. According to Wikipedia, "Carver Mead has developed an approach he calls Collective Electrodynamics in which electromagnetic effects, including quantized energy transfer, derive from the interactions of the wavefunctions of electrons behaving collectively.[2] In this formulation, the photon is a non-entity, and Planck's energy–frequency relationship comes from the interactions of electron eigenstate. The approach is related to John Cramer's transactional interpretation of quantum mechanics, to the Wheeler–Feynman electrodynamics, and to Gilbert N. Lewis's early description of electromagnetic energy exchange at zero interval in space-time.[29]

The quantum world is a world of waves, not particles. So we have to think of electron waves and proton waves and so on. Matter is 'incoherent' when all its waves have a different wavelength, implying a different momentum. On the other hand, if you take a pure quantum system – the electrons in a superconducting magnet, or the atoms in a laser – they are all in phase with one another,

and they demonstrate the wave nature of matter on a large scale. Then you can see quite visibly what matter is down at its heart." [30] Seeing the heart of matter in laser form grounded my visual perception in pure coherency. While working on my proportional theory of perception, this realization led me to a few fundamental questions. What is the meaning (semantics) of the light source? Where is it coming from? Once I recognized that the eye absorbs, emits and stimulates the light, I realized that without light there is no seeing. Light doesn't only emanate from the center or source, where our consciousness resides, because you can see it in the external world. It cannot be external to the structure, either, because we are considering the universe as a whole. So, I finally found the answers to the basic questions of what and where in that little book called "Modern Optics" by Grant R. Fowles.[31] All throughout his discussion on electro-magnetism, he made me realize that physicists describe these light waves as vectors. The branch of mathematics that studies vectors is Vector Calculus. But more importantly, I discovered that it was Carver Mead who distinguished himself by doing all of his work on electromagnetism with the vector potential. For him "the only bright light in the subject was the vector potential." It was with Richard Feynman (the legendary professor from CALTECH) that Mead discovered the possibility of doing "all of electromagnetic theory" with the vector potential. "In the general theory of quantum electrodynamics, one takes the vector and scalar potentials as fundamental quantities in a set of equations that replace the Maxwell equations." By following the "true vintage Feynman" Mead stated that "I discovered the equations of electrodynamics in four-vector form, a four-vector whose space components are the magnetic vector potential and whose time component is the electric scalar potential. According to Feynman "the A- field is "real"… what we mean here by a "real" field is this: a real field is a mathematical function we use for avoiding the idea of action at a distance… a "real" field is then a set of numbers we specify in such way that what happens at a point depends only on the numbers at that point. (Richard Feynman's Lectures on Physics Volume 2 section 15-5).[32]

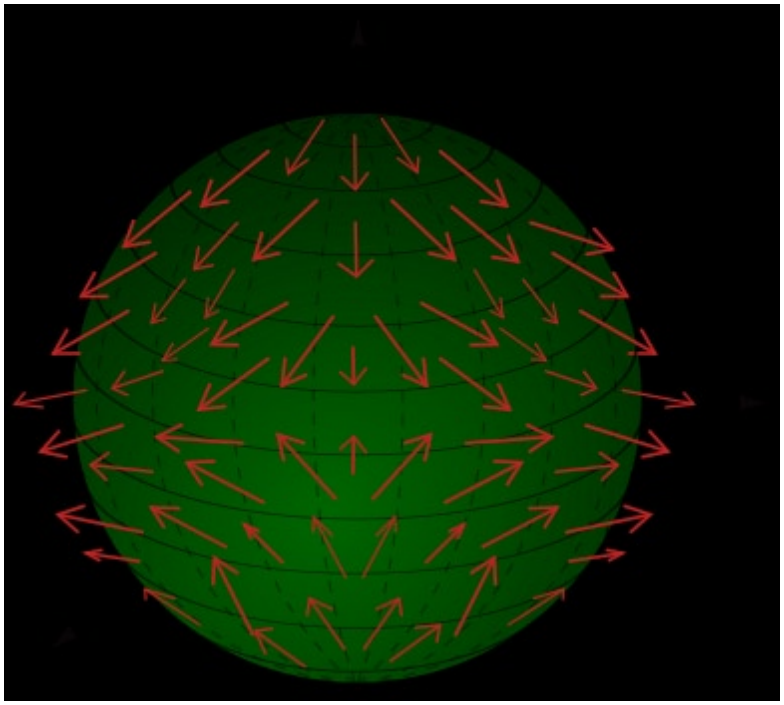


Figure 239. A vector field on a sphere. In mathematics a vector field is a construction in vector calculus which associates a vector to every point in a (locally) Euclidean space. Vector fields are often used in physics to model, for example, the speed and direction of a moving fluid throughout space, or the strength and direction of some force, such as the magnetic or gravitational force, as it changes from point to point. In the rigorous mathematical treatment, (tangent) vector fields are defined on manifolds as sections of a manifold's tangent bundle. They are one kind of tensor field on the manifold.[33] Credit: courtesy of Wikipedia.

Electromagnetic four-potential from Wikipedia

Main article: Electromagnetic four-potential

In the context of special relativity, it is natural to join the magnetic vector potential together with the (scalar) electric potential into the electromagnetic potential, also called "four-potential". One motivation for doing so is that the four-potential turns out to be a mathematical four-vector. Thus, using standard four-vector transformation rules, if the electric and magnetic potentials are known in one inertial reference frame, they can be simply calculated in any other inertial reference frame. Another, related motivation is that the content of classical electromagnetism can be written in a concise and convenient form using the electromagnetic four potential, especially when the Lorenz gauge is used. In particular, in abstract index notation, the set of Maxwell's equations (in the Lorenz gauge) may be written (in Gaussian units) as follows:

$$\partial^\mu A_\mu = 0$$

$$\Box^2 A_\mu = \frac{4\pi}{c} J_\mu$$

where $\Box^2$ is the D'Alembertian and J is the four-current. The first equation is the Lorenz gauge condition while the second contains Maxwell's equations. Yet another motivation for creating the electromagnetic four-potential is that it plays a very important role in quantum electrodynamics.[34]

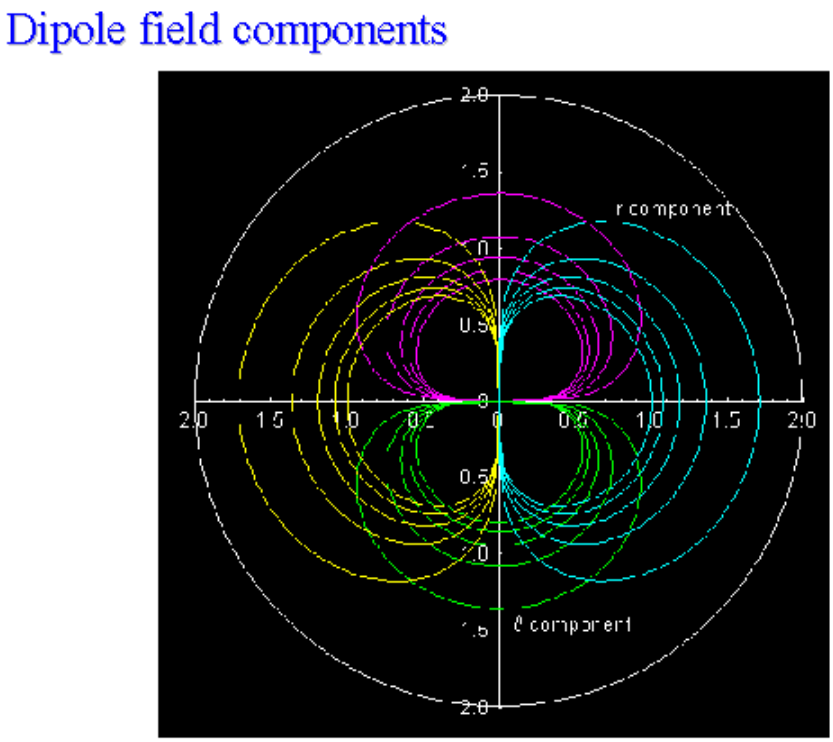


Figure 240. The Magnetic vector potential. In physics, the magnetic potential is a method of representing the magnetic field by using a potential value instead of the actual **B** vector field. There are two methods of relating the magnetic field to a potential field and they give rise to two possible types of magnetic potential, as a scalar and as a vector potential. (Note, however, that the magnetic vector potential is used much more often than the magnetic scalar potential.) The magnetic vector potential is often called simply the magnetic potential, vector potential, or electromagnetic vector potential. If the magnetic vector potential is time-dependent, it also defines a contribution to the electric field.[35] Credit; courtesy of Wikipedia

As you can see above, the magnetic vector potential gives us a directed insight into the lambdasphere (the electron cyclotron maser/laser in the magnetosphere and the Auroras). This global insight about the vector potential is perhaps what motivated Richard Feynman to ask. "What is the advantage of the vector potential? We will see that in more advanced theoretical matters (in relativity, in advanced formulations of the laws of mechanics, like the principle of least action… and in quantum mechanics) the vector potential plays an important role… It is, in fact, just because momentum and energy play a central role in quantum mechanics that A and Φ provide the most direct way of introducing electromagnetic effects into quantum descriptions.[36] For Mead, Feynman "had separated science into two worlds: quantum and classical. For him, the vector potential was primary in the quantum world. These two worlds had not yet come together. For Mead the macroscopic (classical) and microscopic (quantum) worlds are now unified coherently thanks to the vector potential. The story of the vector potential actually started with Michael Faraday in 1851, when he recognized that the magnetic lines of force not only circulate outside the magnet but also inside of it. This insight was later appropriated mathematically by Maxwell who used it as a foundational concept in the formulation of his theory of electromagnetism. It is very important to realize that Maxwell derived the classical equations of the E (electrical field) and B (magnetic field) from A (the vector potential). But, according to Mead the fact that Maxwell was wedded to the false concept of the Ether he narrowly missed the connecting link between the quantum world and the electromagnetic field. Furthermore he set the stage for the vector potential to be discarded by Heaviside and Hertz as a mere scaffolding device in the establishment of the classical equation of electromagnetism that are still being used today. The "severe blow" that this derailment inflicted on the theory of electromagnetism not only impeded the understanding of the quantum foundation of electromagnetism but also impeded the connection between Einstein's theory of relativity and quantum physics.

Akira Tonomura in his book; The Quantum World Unveiled by Electron Waves, also shows us the relevance of the vector potential. According to an Amazon reviewer "this is a wonderful book clearly describing beautiful experiments. This masterpiece of scientific writing describes fundamental phenomena in quantum mechanics, while avoiding technical jargon. In the process of developing holography electron microscope technology, Dr. Tonomura's group has successfully visualized a number of striking quantum phenomena. The "double-slit experiment with electrons" is a classic experiment described now even in first year physics textbooks. The definite proof of the Aharonov-Bohm effect is also clearly described in this enjoyable book. Moreover, the visualization of the spatial-temporal dynamics of vortices in superconductors is also presented with clarity and sufficient details. These are all experiments pioneered in the author's laboratory. The over-arching theme of the author, and this book, is the ability to actually see the quantum phenomena occurring at the nanoscales. This ability is allowing an unprecedented level of understanding of quantum phenomena. Readers will be delighted with this book. It is a gem. The illustrations are illuminating and beautiful (enjoyed even by my very young daughter). This is a strongly recommended book for anyone interested in quantum mechanics." [37]

Our laser informed consciousness is derived from the coherent light source or the transduction of the vector potential into the action potential of the visual neuron. The light source produces and determines what we see and how we think. Most discussions about vectors have to do with the motion and direction of light waves. But they rarely discuss the vector potential as the light source of perception itself. Surely the visual process is discussed but they never mention or acknowledge the relevance of the nature of light, whether it is coherent or incoherent and much less of its meaning or semantics. For me the vector concept and its perception resulted from a synthesis of reading modern optics in conjunction with Mead, Einstein's A & B proportional coefficients and the phenomenological tradition (Husserlian philosophy) with Gestalt psychology. According to Wikipedia; "For Edmund Husserl, phenomenology is "the reflective study of the essence of consciousness as experienced from the first-person point of view."[12] Phenomenology takes the intuitive experience of phenomena (what presents itself to us in phenomenological reflexion) as its starting point and tries to extract from it the essential features of experiences and the essence of what we experience. When generalized to the essential features of any possible experience, this has been called "transcendental phenomenology". Husserl's view was based on aspects of the work of Franz Brentano and was developed further by philosophers such as Maurice Merleau-Ponty, Max Scheler, Edith Stein, Dietrich von Hildebrand and Emmanuel Levinas."[38]

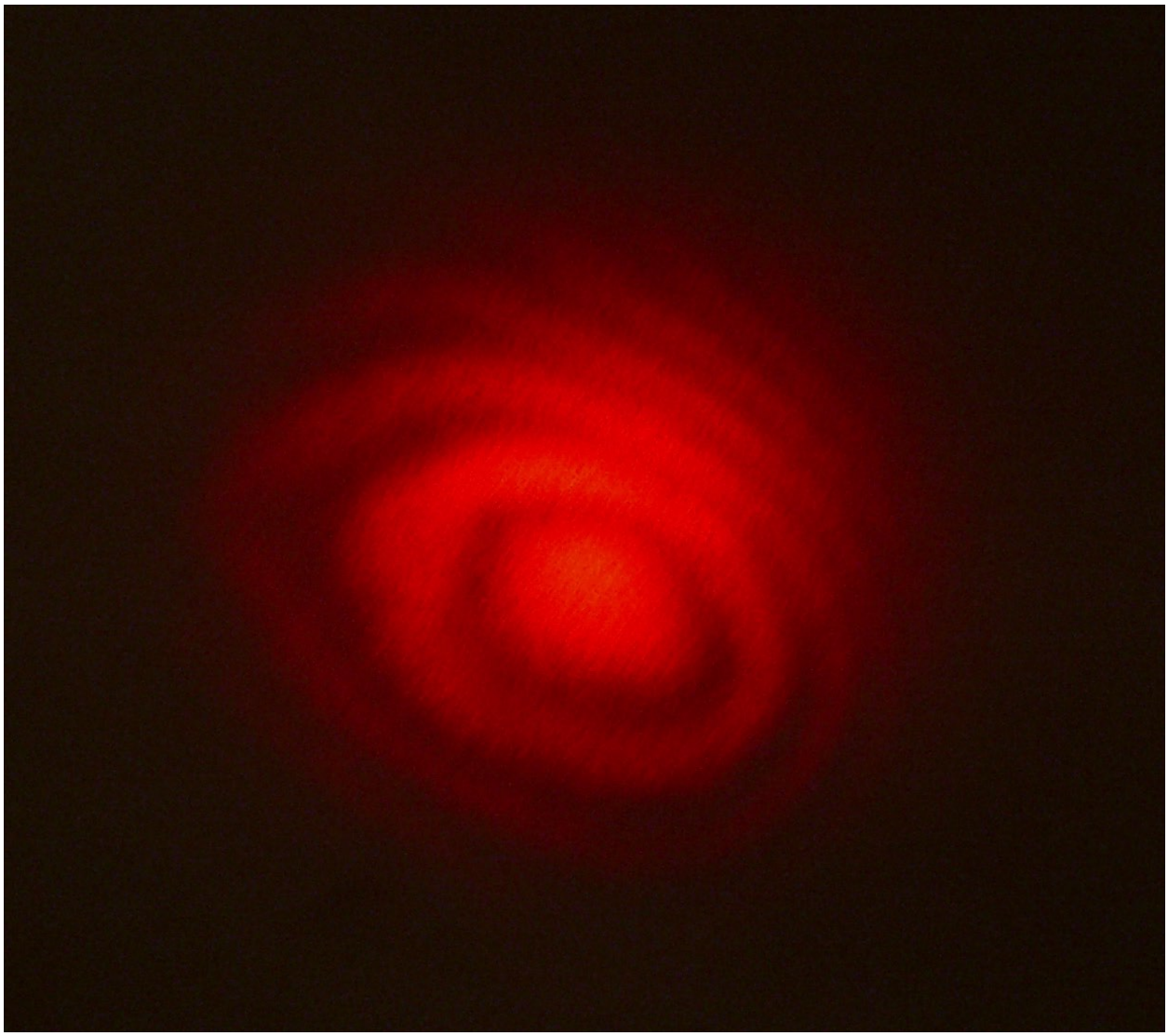


Figure 241. Interference pattern produced with a Michelson Interferometer using a red laser. The Michelson–Morley experiment, one of the most important and famous experiments in the history of physics, was performed in 1887 by Albert Michelson and Edward Morley at what is now Case Western Reserve University. It is generally considered to be the first strong evidence against the theory of a luminiferous aether. The experiment has also been referred to as "the kicking-off point for the theoretical aspects of the Second Scientific Revolution."[1] Primarily for this work, Albert Michelson was awarded the Nobel Prize in 1907. Courtesy of Wikipedia.[39]

So when I became aware of Mead's vector potential concept of light I suddenly realized that the light source is not only the foundation of our visual perception but that it is the perceptual flow itself (the thing itself) or noumenon. According to Wikipedia "The noumenon (plural: noumena) classically refers to an object of human inquiry, understanding or cognition. It is a posited object or event as it is in itself independent of the senses.[1] The term is generally used in contrast with, or in relation to, "phenomenon" (plural: phenomena), which refers to appearances, or objects of the senses. A phenomenon can be an exceptional, unusual, or abnormal thing or event -- but it must be perceptible through the senses; A noumenon cannot be the actual object that emits the phenomenon in question. Noumena are objects or events known only to the imagination - independent of the senses."[40] This understanding placed Einstein's creative imagination into a deeper subjective perspective.

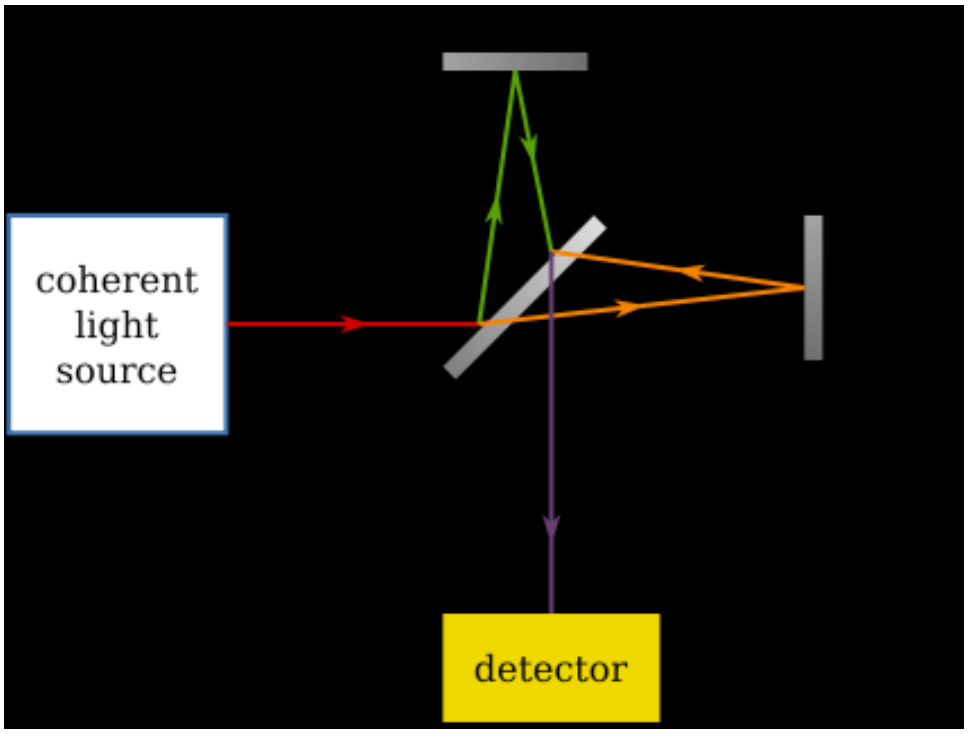


Figure 242. The Michelson–Morley experiment was used to disprove that light propagated through a luminiferous aether. This 19th century concept was then superseded by Albert Einstein's special theory of relativity. Courtesy of Wikipedia.[41]

In Husserlian phenomenology[42] this noumena is captured through apperception, from the Latin ad + percipere, to perceive. "In philosophy, Kant distinguished empirical apperception from transcendental apperception. The first is "the consciousness of the concrete actual self with its changing states", the so-called "inner sense". The second is "the pure, original, unchangeable consciousness which is the necessary condition of experience as such and the ultimate foundation of the synthetic unity of experience" (Otto F. Kraushaar in Runes)."[43] This dual view of apperception connected my understanding of the moral sense within the mirror neurons system of the brain[44] to Husserl's sense of empathy. "In phenomenology, empathy refers to the experience of another human body as another subjectivity: You see another body, but you immediately perceive another subject. In Husserl's original account, this was done by apperception built on the experiences of your own lived-body which you experience in a dual way, both as object (you can touch your own hand) and as your own subjectivity (you are being touched). This experience of your own body as your own subjectivity is then applied to the experience of another's body, which, through apperception, is constituted as another subjectivity. This experience of empathy is important in the phenomenological account of intersubjectivity."[45]

The coherent wave structure of visual perception enables you to see yourself seeing as another person because it is self reflective in the mirror neurons and because it focuses the consciousness on the global act of seeing the vector flow of the light itself and not only on the symbols or objects of perception. For example, ordinarily when we look at the world we see a multiplicity of objects in the background of which one is summoned to the foreground where we focus our attention. This moment of the process localizes the interaction between subject and object creating the illusion of duality, where we think is just the object and I out there. What is illusive about this event is not the local interaction—which is quite real—but the incomplete perception of the global reality (metaphorically illustrated below in the six-fold vector of the Bose-Einstein structure figure 246)[46] due to the sense of atomicity (separateness) or apparent discreteness that results from the transduction of incoherent light in the retina. This local and incoherent interaction is what leads to that inevitable lost of information (awareness). Einstein's proportional vision of light in its vector potential and scalar quantum wave or coherent form not only resolved the dualistic (object-subject, macro-micro or mind-body) impasse that has kept most theories of knowledge imprisoned by this false dichotomy, but most of all it guided me to a more holistic interdependent view of the relativistic-quantum consciousness of life.[47]

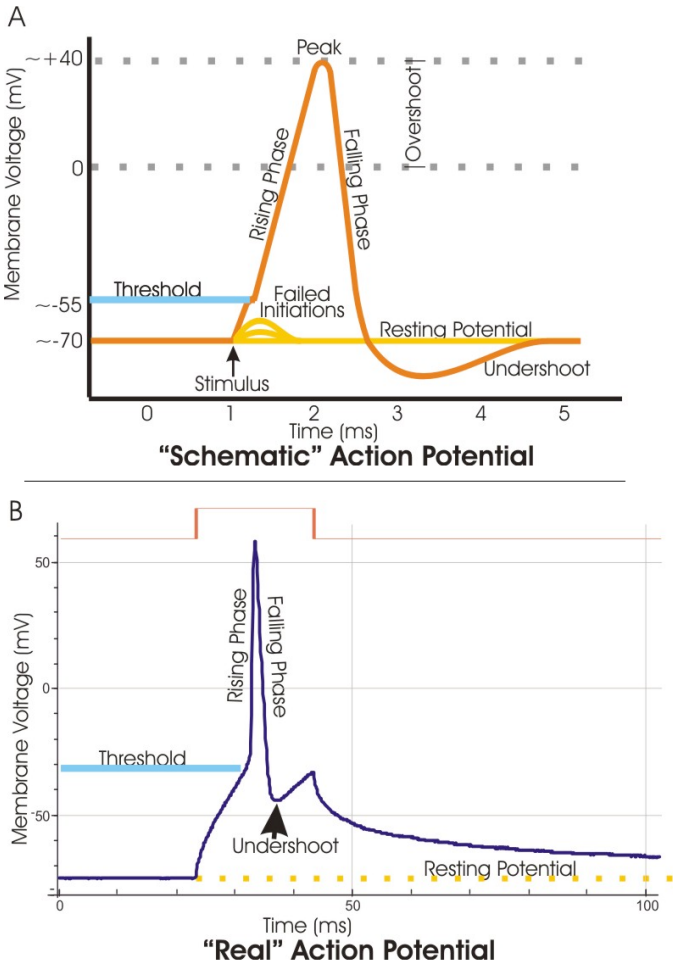


Figure 243. A. Schematic view of an idealized action potential illustrates its various phases as the action potential passes a point on a cell membrane. B. Actual recordings of action potentials are often distorted compared to the schematic view because of variations in electrophysiological techniques used to make the recording. In neurophysiology, an action potential (also known as a nerve impulse or spike) is a pulse-like wave of voltage that travels along several types of cell membranes. The best-understood example is generated on the membrane of the axon of a neuron, but also appears in other types of excitable cells, such as cardiac muscle cells, and even plant cells. The resting voltage across the axonal membrane is typically −70 millivolts (mV), with the inside being more negative than the outside. As an action potential passes through a point, this voltage rises to roughly +40 mV in one millisecond, then returns to −70 mV. The action potential moves rapidly down the axon, with a conduction velocity as high as 100 meters/second (224 miles per hour). Because they are able to transmit information so fast, the flow of action potentials is a very efficient form of data transmission, considering that each neuron the signal passes through can be up to a meter in length.[note 1][48]

I propose the following thesis on the proportional equivalence between Einstein's radiant thoughts and its emergence in the real world and the laser light that illuminates the LaserFusion and LaserDrilled Geothermal power systems that are emerging for the photonic power line networks (power, video, audio and data over fiber and free space optics). Fusion Power is to Geothermal Power what Photonic Power is to Brain Power. Just as geothermal power transduces and distributes the solar fusion power into the biosphere, Laser brain power transduces and distributes the photonic power to the Living body. Einstein drew out the coherent light from the quantum background of nature and projected it unto the foreground of scientific knowledge. In turn, the scientific coherence in the foreground of society became a self–reflecting mirror that awakened our visual consciousness. My proportional vision (A is to B what C is to D) emerged from a geometrical study of the Golden Ratio (1.618).[49] This vision was extended with the principles of Gestalt psychology (a holistic theory of perception)[50] and interpreted with the transcendental logic (cognitive phenomenology of self-reflection) of Edmund Husserl[51] via a translation I performed on a French book called: The Absolute Structure, Essay in Genetic Phenomenology by Raymond Abellio (Gallimard edition 1965).[52] Reflection on the meaning of this proportional theory of perception led me to the identification of Einstein's proportionality constants A (A21, A12) and B (B21 and B12) or coefficients in his laser theory of 1916. This identification became the most productive and homological (structurally identical) focus of my proportional investigation, culminating in my LaserEmpowered Vision. It struck me as lightning when I discovered that Einstein's proportional vision of the laser was in homological correspondence with the relativistic example of the Lightning he employed in his 1916 book on Relativity. I was also galvanized by the intimate knowledge of Einstein's radiant thoughts as they are published in his Collected Papers around the original moments of his conception in 1916. (The Collected Papers of Albert Einstein, Volume 6, The Berlin Years: Writings, 1914-1917).[6]

By following my LaserEmpowered intuition I discovered that the development of Einstein's brilliant idea not only gave us coherent light, but that it was arguably Einstein's most productive scientific contribution to the advancement of civilization. Thanks to the laser we are re-creating ourselves in the image of pure and practical reason. I also found that through Einstein's proportional vision

of coherent light we are developing our natural powers to be fruitful stewards of this laser intelligence within our universe. I saw how this light has expanded our vision to the farthest reaches of the universe as well as to the inner sanctum of the quantum world. And in another truly amazing discovery I saw how through that simple act of questioning Bohr's incoherent light source, Einstein became the father of our macroscopic, microscopic, and laser spectroscopic[53] understanding of the constant (invariant) nature of light. The stereoscopic and dynamic holographic vision of intelligence that is emerging on the internet also has its roots in this 'brilliant idea'. Ultimately he became the true founder of the New Civilization, because he revealed to mankind the most powerful light of the universe. And today, with our LaserEmpowered Eyes intensified and amplified by Microvision's VRD this new Laser Empowerment is opening new possibilities for the transduction of sickness into health, of poverty into wealth and ignorance into wisdom for all mankind.

To truly understand the fundamental unity between Einstein's LaserEmpowered Vision and its extension to LaserFusion and LaserDrilled Geothermal Power, it will be necessary for us to appropriate this profound visualization subjectively, where we see our eyes as laser transducers within the space-time continuum of coherent light. Correlatively on the objective side in order to realize this project and to arrive at the correct quantum result on the optical Internet, we ought to understand it as the Lambdasphere. According to Carver Meade, we need to; "Take into account the interaction of the electron with itself… By using a continuous, self-interacting quantum system as the conceptual basis for electromagnetic theory, we have advanced one step closer to a simpler and more unified discipline… This monograph (Collective Electrodynamics) has shown how the traditional discipline of electromagnetism is most economically viewed as the study of the coherent electron wave functions. These wave functions are continuous in space, representing a charge distribution that is distributed in space, and that interacts with itself. Any theory based on this view is essentially non-linear in nature; so the conceptual problem was not how energy is radiated by the oscillating wave function, but how the transition can be initiated in the first place. It is by now a common experimental fact that an atom, if sufficiently isolated from the rest of the universe, can stay in an excited state for an arbitrarily long period. It is also true that achieving that degree of isolation was not possible until the last few years. The mechanism for initiating an atomic transition is not present in the isolated atom; it is the direct result of coupling with the rest of the universe…"[54] This atomic coupling is the fundamental quantum reason why we need to individually connect to the continuum of coherent light via the VRD on the internet with others. By placing his mind within the space-time continuum, Einstein transcended the atomicity of his personal and professional life and was able to live a fruitful, collective and cosmic life style for the benefit of all of us. This is the marriage of our brains with the Universe via Lasers, establishing thereby the foundation for the Laser Information world.

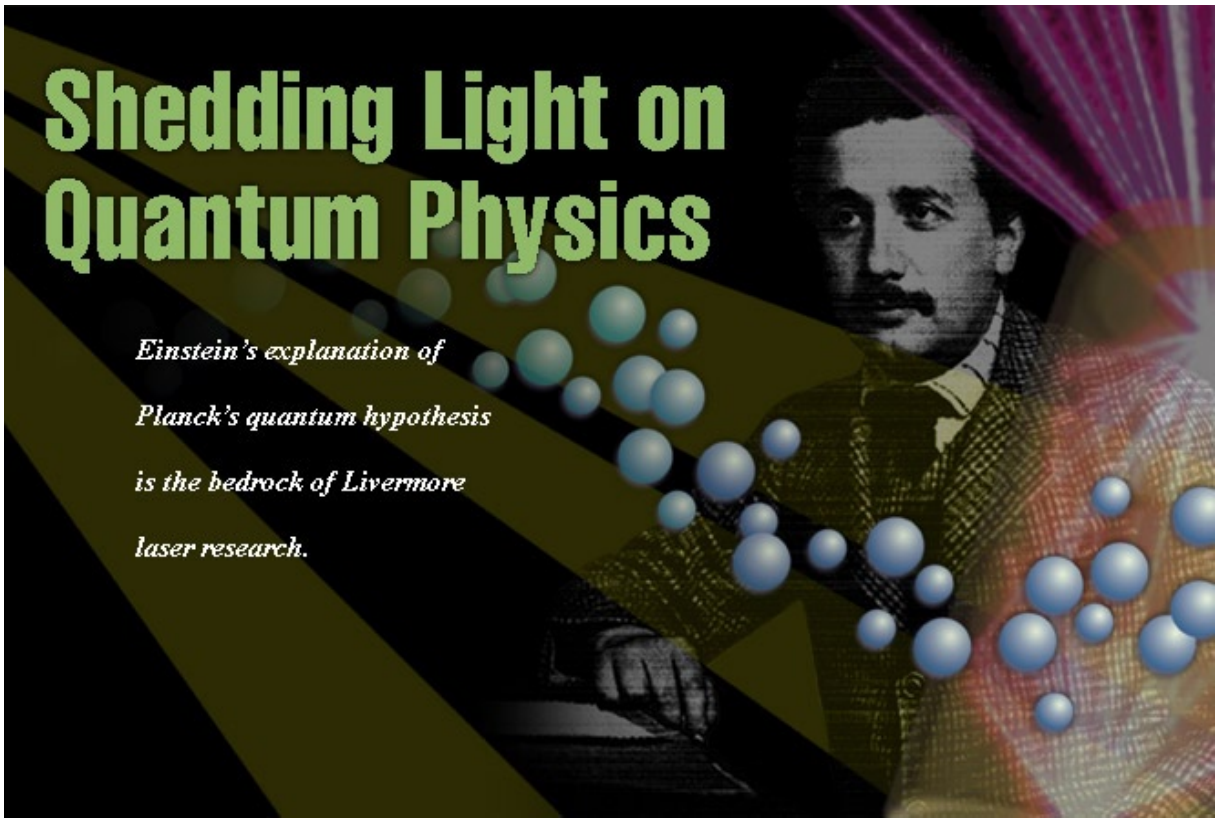


Figure 244. I feel that it is a delusion to think of the electrons and the fields as two physically different, independent entities. Since neither can exist without the other, there is only one reality to be described, which happens to have two different aspects; and the theory ought to recognize this from the start instead of doing things twice…55." A. Einstein. Credit: courtesy of Laurence Livermore Laboratory.56

Einstein in his popular book: RELATIVITY, THE SPECIAL AND GENERAL THEORY, (1916) wrote that "LIGHTNING struck the rails on our railway embankment at two places A and B far distant from each other."[57] Through this act of theorizing or visualizing from the invariance of light he not only transduced the Newtonian notion of an absolute space and time but more importantly made us realize that the true constant of nature is now the space-time continuum of light.[58] In Albert Einstein, Creator and Rebel by Banesh Hoffmann with Helen Dukas', the authors gave us a brilliant homological example of Einstein's Lightning with the following proportional idea: A {a1 → a2} and B {b1→ b2}. [59] This Homology or structurally identical formulation of the relativity proportion to his quantum theory of radiation led me to see how the LaserFusion power system actually emerged from Einstein proportional vision of light on both the quantum (Micro-scale) and the relativity (Macro-scale) side. This homological inspection of Einstein's relativistic example of lightning striking points A and B led me directly to the idea of "emission and absorption of radiation in quantum theory."

Figure 245. Lightning is the electric breakdown of air by strong electric fields, producing a plasma, which causes an energy transfer from the electric field to heat, mechanical energy (the random motion of air molecules caused by the heat), and light.[60] Credit: courtesy of Wikipedia [61]

In his book "Introduction to Modern Optics" section 9.2 Stimulated Emission and Thermal Radiation; Grant R. Fowles writes "Einstein in 1917 first introduced the concept of stimulated or induced emission of radiation by atomic systems. He showed that in order to describe completely the interaction of matter and radiation, it is necessary to include that process in which an excited atom may be induced, by the presence of radiation, to emit a photon, and thereby decay to a lower energy state… (See section 2.6 above) An atom in level 2 can decay to level 1 by emission of a photon. Let us call A21 the transition probability per unit time for spontaneous emission from level 2 to level 1… In addition to these spontaneous transitions, there will be induced or stimulated transitions. Let B21 and B12 denote the proportionality constants for Stimulated Emission Radiation and absorption. The proportionality constants in the above expression are known as the Einstein A and B coefficients."[62] Even though Fowles omitted A12 in this discussion, which is the incoherent absorption, I knew at this instant that I had found the inner core to Einstein's proportional vision of lasers. This initial finding of Einstein's A21, A12 and B21 ,B12, coefficients within the quantum phenomena of light immediately justified my juxtaposition of the two conceptual spaces of Laser-Empowerment or more precisely the conceptual transition that went from the Laser to the Empowerment of reason via the A and B homology. The understanding of Einstein's LaserEmpowered Vision came to me via this proportional structure of light.

In a confession to a friend Einstein stated that, "when I examine myself and my methods of thought, I come close to the conclusion that the gift of imagination has meant more to me than my talent for absorbing absolute knowledge."[63] He had an intuitive and artistic imagination that balanced and inspired his rigorous scientific concentration. My proportional studies of visual perception were now connected and clearly established with Einstein's conception of Laser Light. The convergence between Einstein's A (A21, A12) and B (B21 and B12) coefficients and my proportional vision immediately became evident. For Einstein, the spherical structure of light is an invariant, signifying that it is continuously unchanging (constant) in space-time. And because of this invariance it is possible to simplify and illustrate the behavior of light with an example from the Bose-Einstein Condensation of the world without altering the fundamental character of the law. Einstein's proportionally brilliant idea as A and B Coefficients was now inscribed and coherently transduced into a proportional vision of perception (the Bose-Einstein apparatus, six laser beams in the structural directions shown in figure 248 below).

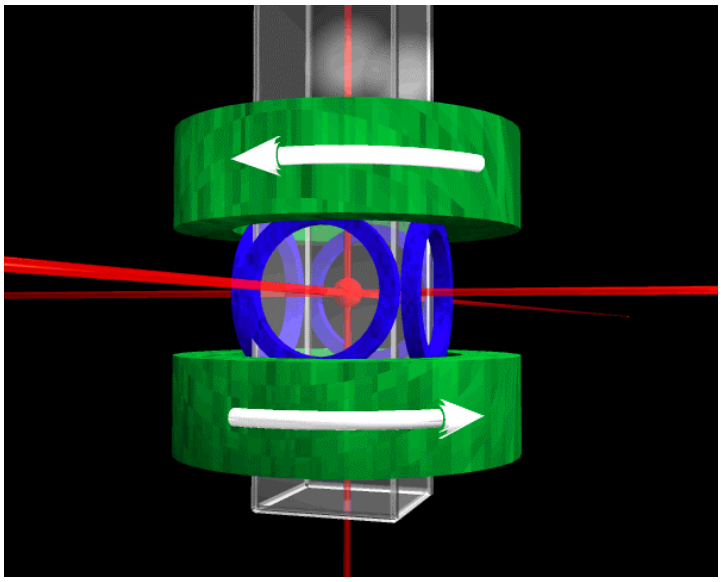


Figure 246. The Schematic of the first apparatus used to create BEC (six laser beams in the Bose-Einstein structure of perception shown above) is now at the Smithsonian Institution. The condensation was first achieved at 10:54 a.m. on June 5, 1995, in a laboratory at JILA. JILA is an interdisciplinary institute for research and graduate education in the physical sciences. Light from diode lasers comes from all six directions to form a MOT (magneto optical trap) in the middle of the cell. Running laser current through the magnetic field coils shown surrounding the cell creates the magnetic trap. Credit: courtesy of JILA.[64]

Einstein's coefficients are metaphorically[65] constituted in this study by the horizontal four-fold vectors of that structure, and the resultant vision that vertically informed the world. A21 is to A12 what B21 is to B12 where A21 is now a directed transition of coherent emissions or descent from atomic level 2 to level 1. A12 is the electromagnetic ascent from atomic level 1 to level 2 for the absorption of coherent light. B21 and B12 denote respectively the proportionality constants for stimulated emission radiation (descent of the coherent electron wave function) and absorption of coherent light. The two A vectors correspond to the coherent objective side of what's perceived in the Bose-Einstein condensate. For example, starting from the coherent background of the quantum world to an atomic object, vector A21 illuminates an object in the foreground. From the object to our eyes, vector A12 is absorbed and transduced by the cones and rods in the retina, this is the local sensation. The population inversion and the transduction accomplished in the retina transmit to the visual cortex a coherent signal. The two B vectors correspond to the coherent subjective side of the perceiver. B21 transmits the coherent signal via the neural network to the whole body B12 for conscious and unconscious processing or absorption. The body is now in a global coherent perception or conscious contact with the Bose-Einstein world. The left-handed rule of Einstein's proportional vision in the Lambdasphere produced the downward vertical vector that influenced the research and development of a multiplicity of Laser technologies in medicine and in all the major industries of society as tools of great utility. Einstein's vision in this direction also became the foundation for the dense wavelength division multiplexing technologies (DWDM) that are currently incarnating and augmenting our coherent power over the incoherent world on the internet. This downward vector is also coherently conquering the unconscious domain of decoherence in the brain with Microvision's Retinal Laser Display.

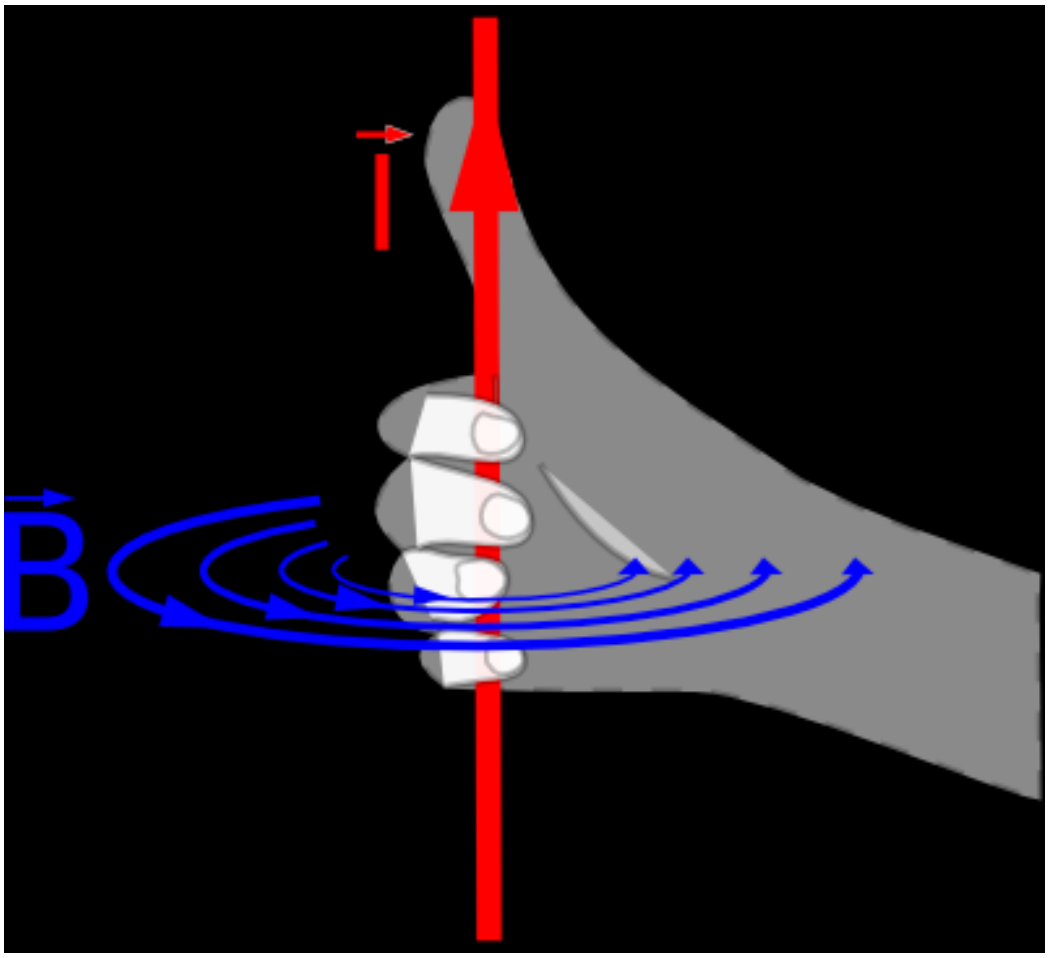


Figure 247. Credit Courtesy of Wikipedia. In mathematics and physics, the right-hand rule is a common mnemonic for understanding notation conventions for vectors in 3 dimensions. It was invented for use in electromagnetism by British physicist John Ambrose Fleming in the late 1800s.[1][2] Normally, for an electromagnetic wave, the electric and magnetic fields, and the direction of propagation of the wave obey the right-hand rule. In certain situations, it may be useful to use the opposite convention, where one of the vectors is reversed and so creates a left-handed triad instead of a right-handed triad. An example of this situation is for left-handed materials. Normally, for an electromagnetic wave, the electric and magnetic fields, and the direction of propagation of the wave obey the right-hand rule. However, left-handed materials have special properties - the negative refractive index. It makes the direction of propagation point in the opposite direction. A metamaterial (or meta material) is a material which gains its properties from its structure rather than directly from its composition. To distinguish metamaterials from other composite materials, the metamaterial label is usually used for a material which has unusual properties. The term was coined in 1999 by Rodger M. Walser of the University of Texas at Austin. He defined metamaterials as:[1] Macroscopic composites having a manmade, three-dimensional, periodic cellular architecture designed to produce an optimized combination, not available in nature, of two or more responses to specific excitation.

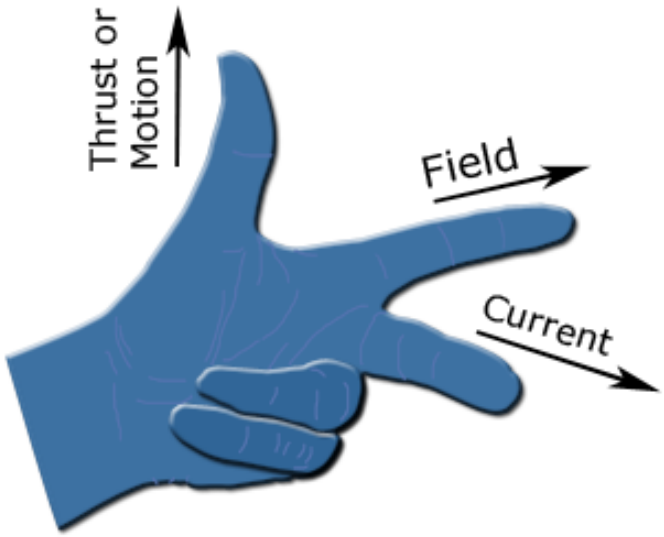


Figure 248. Credit Courtesy of Wikipedia. Fleming's left hand rule, De Graaf's translation of Fleming's left-hand rule - which uses thrust, field and current - and the right-hand rule, is the FBI rule. The FBI rule changes Thrust into F (Lorentz force), B (direction of the magnetic field) and I (current). The FBI rule is easily remembered by US citizens because of the commonly known abbreviation for the Federal Bureau of Investigation…[66]

Electromagnetics researchers often use the term metamaterials, quite narrowly, for materials which exhibit negative refraction. W.E. Kock developed the first metamaterials in the late 1940s with metal-lens antennae[2] and metallic delay lenses.[3] Metamaterials are of particular importance in electromagnetism (especially optics and photonics). They show promise for a variety of optical and microwave applications such as new types of beam steerers, modulators, band-pass filters, lenses, microwave couplers, and antenna radomes. A metamaterial affects electromagnetic waves by having structural features smaller than the wavelength of the electromagnetic radiation it interacts with. For instance, if a metamaterial is to behave as a homogeneous material accurately described by an effective refractive index, its features must be much smaller than the wavelength. For visible light, which has wavelengths of less than one micrometer typically (560 nanometers for sunlight), the structures are generally half this size or smaller; i.e., less than 280 nanometers. For microwave radiation, the structures need only be on the order of one decimetre. Microwave frequency metamaterials are almost always artificial, constructed as arrays of electrically conductive elements (such as loops of wire) which have suitable inductive and capacitive characteristics. Metamaterials usually consist of periodic structures, and thus have many similarities with photonic crystals and frequency selective surfaces. However, these are usually considered distinct from metamaterials, as their features are of similar size to the wavelength at which they function, and thus cannot be approximated as a homogeneous material. [67]

Development and applications

The first metamaterials were developed by W.E. Kock in the late 1940s.[5] The unique properties of metamaterials were verified by full-wave analysis in Caloz et al. (2001).[6] However, the LH structures devised up to 2002 were impractical for microwave applications because they had a too narrow bandwidth and were quite lossy. Eleftheriades et al. (2002) and Caloz et al. (2002) provided a method to realize left-handed metamaterials using artificial lumped-element loaded transmission lines in microstrip technology.[7][8] What needs to be built with these metamaterials is a personal superlens that we can use for deep scientific visualization of DNA molecules and other microscopic entities. A superlens is a lens which is capable of subwavelength imaging. Conventional lenses have a resolution on the order of one wavelength due to the so-called diffraction limit. This limit makes it impossible to image very small objects, such as individual atoms, which have sizes many times smaller than the wavelength of visible light. A superlens is able to beat the diffraction limit. A very well-known superlens is the perfect lens described by John Pendry, which uses a slab of material with a negative index of refraction as a flat lens. In theory, Pendry's perfect lens is capable of perfect focusing—meaning that it can perfectly reproduce the electromagnetic field of the source plane at the image plane.[68]

The first superlens with a negative refractive index provided resolution three times better than the diffraction limit and was demonstrated at microwave frequencies at the University of Toronto by A. Grbic and G.V. Eleftheriades.[9] Subsequently, the first optical superlens (an optical lens which exceeds the diffraction limit) was created and demonstrated in 2005 by Xiang Zhang et al. of UC Berkeley, as reported that year in the April 22 issue of the journal Science,[10] but their lens did not rely on negative refraction. Instead, they used a thin silver film to enhance the evanescent modes through surface plasmon coupling. This idea was first suggested by John Pendry in Physical Review Letters.

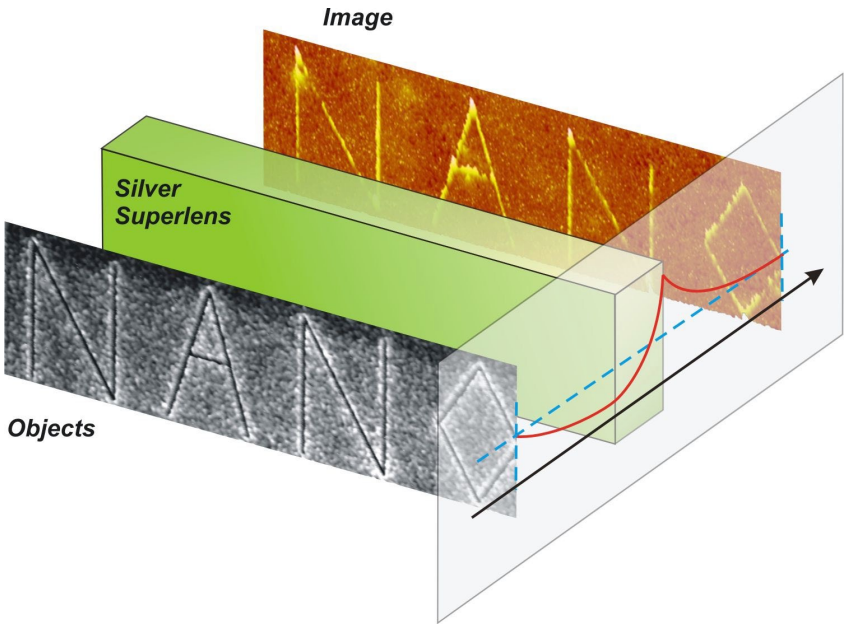


Figure 249. (Credit Image by Cheng Sun, UC Berkeley). Shown is a drawing of nano-scale imaging using a silver superlens that achieves a resolution beyond the optical diffraction limit. The red line indicates the enhancement of "evanescent" waves as they pass through the superlens. New superlens opens door to nanoscale optical imaging, high-density optoelectronics. Berkeley -- A group of scientists at the University of California, Berkeley, is giving new relevance to the term "sharper image" by creating a superlens that can overcome a limitation in physics that has historically constrained the resolution of optical images. Using a thin film of silver as the lens and ultraviolet (UV) light, the researchers recorded the images of an array of nanowires and the word "NANO" onto an organic polymer at a resolution of about 60 nanometers. In comparison, current optical microscopes can only make out details down to one-tenth the diameter of a red blood cell, or about 400 nanometers.[69]

These metamaterials and their negative refractive index will soon be available not only for visualization but for personal experimentation, innovation and creation via MIT FAB Labs. According to Wikipedia; Neil Gershenfeld is a professor at MIT and the head of MIT's Center for Bits and Atoms, a sister lab spun out of the popular MIT Media Lab. His research interests are mainly in interdisciplinary studies involving physics and computer science, in such fields as quantum computing, nanotechnology, personal fabrication, and other research areas. His lab is currently located in the E15 building at MIT, but he has received funding to build a substantial extension to the building, shaped like a castle, which will house his lab in the future. His books include When Things Start to Think, The Nature of Mathematical Modeling, The Physics of Information Technology, and Fab, The Coming Revolution on Your Desktop - From Personal Computers to Personal Fabrication (ISBN 0-465-02745-8). In 2004, Gershenfeld was named to the Scientific American 50.[1] The magazine has also named him Communications Research Leader of the Year. Classes at the Center include "How To Make (almost) Anything" (MAS 863) and "How To Make Something That Makes (almost) Anything" (MAS 961). It is here that MIT's motto of Mind and Hand (Mens et Manus) or learning by doing shines most clearly.[70] Go to MAS.863: How to Make (Almost) Anything: Home > Courses > Media Arts and Sciences > How to Make (Almost) Anything. Course Highlights: This class teaches the use of several types of CAD/CAM machines, and techniques for making literally 'almost anything'. The lecture notes include valuable tips on how to make those machines work, and links to other web sites with detailed information on the world of CAD/CAM: Course Description. This course provides a hands-on introduction to the resources for designing and fabricating smart systems, including CAD/CAM/CAE; NC machining, 3-D printing, injection molding, laser cutting; PCB layout and fabrication; sensors and actuators; analog instrumentation; embedded digital processing; wired and wireless communications. This course also puts emphasis on learning how to use the tools as well as understand how they work.

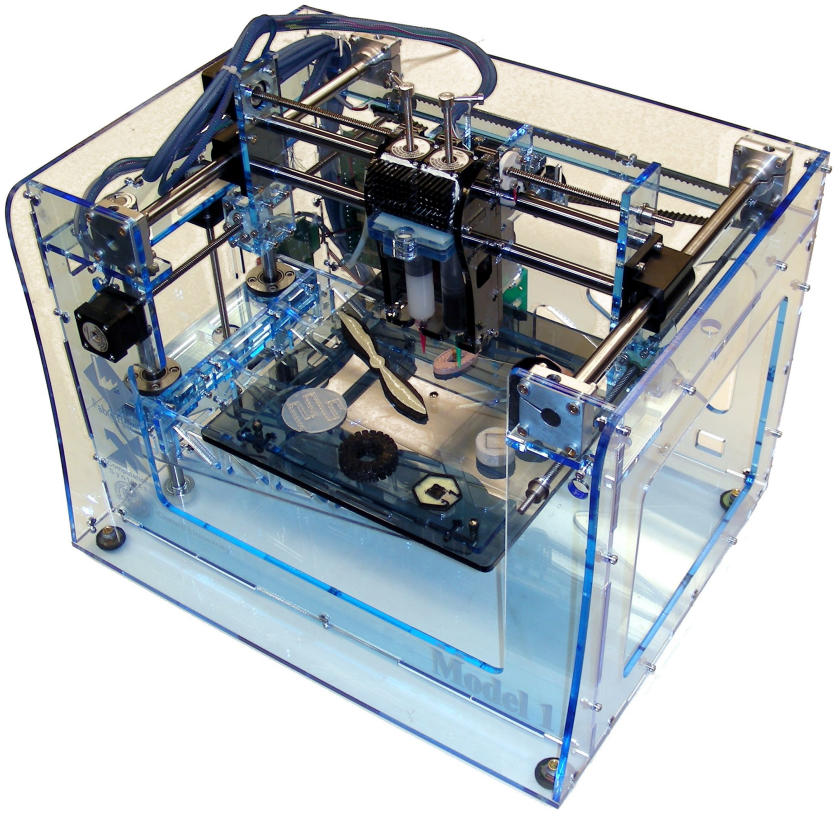


Figure 250. A Fab@Home Fabber. Credit courtesy of Wikipedia. Fab@Home is a project dedicated to making and using fabbers - machines that can make almost anything, right on your desktop. This website provides everything you need to know in order to build or buy your own simple fabber, and to use it to print three dimensional objects. The hardware designs and software on this website are free and open-source. Once you have your own fabber, you can also download and print various items, try out new materials, or upload and share your own projects. Advanced users can modify and improve the fabber itself. Fabbers (a.k.a. 3D printers or rapid prototyping machines) are a relatively new form of manufacturing that builds 3D objects by carefully depositing materials drop by drop, layer by layer. With the right set of materials and a geometric blueprint, you can fabricate complex objects that would normally take special resources, tools and skills if produced using conventional manufacturing techniques. A fabber can allow you to explore new designs, email physical objects to other fabber owners, and most importantly - set your ideas free. Just as MP3s, iPods and the Internet have freed musical talent, we hope that blueprints and fabbers will democratize innovation. [71]

On the other side, the right-handed rule of Einstein's proportional vision (figure 248) produced the upward vertical vector that directed our findings of the unified sense of matter in the Bose-Einstein condensate (the fifth state of coherent matter or ideal Gas). In the coherent quantum brain metaphor the unified sense of matter comes through the sensory system of the retina and interacts with the DNA instructions in the visual cortex. Einstein's coherent vision in this direction also influenced the search for the unification of the world that the Lambdasphere is making possible via the Internet (the all-optical laser network of networks) and the laser fusion star model. The global understanding of Einstein's LaserEmpowered Vision in the 5th state of matter (Bose-Einstein Condensation) will in turn give mankind control and access to the coherent generation of the geomagnetic waves on the Auroras (Borealis and Australis) and eventually to the whole cosmos through the plasma (electrically charged or ionized gas in the fourth state of coherent matter) of its Laser fusion Stars. Moreover, the global knowledge-base of the Bose-Einstein Structure of perception in this sense allows mankind to fulfill itself completely. And finally through the radiant center at rest or coherent seed of awareness, mankind's rational consciousness directed the global movement of Einstein's spherical perception because of his reasoned inquiry. Through this Lambdasphere, mankind extended its coherent Light of Life, Love and Truth to the whole universe. With Einstein's LaserEmpowered Vision serving as our guide to the truth of life, it will now be transducing our natural coherent vision of the incoherent world into a coherent vision of the Lambdasphere. Now we have access to the harmony of a truly beautiful and good world. In this cognitive schema the Bose-Einstein Structure is a fruit derived from the coherent labor of thought that illuminated the radiant character of those precious scientists.

The pictures in figure 253 below are a first glimpse of the unified sense of matter in the Rubidium molecules of a BEC experiment. That 12 vortex array is very significant because it is homologically or numerologically identical to the structure (21-12) of our laser theory. This structure of the mirror number 21-12 was the key that opened the inner door of my imagination and led me to the investigation of chirality. According to Wikipedia; in geometry, a figure is chiral (and said to have chirality) if it is not identical to its mirror image, or more particularly if it cannot be mapped to its mirror image by rotations and translations alone, like our right and left hand. A chiral object and its mirror image are said to be enantiomorphs. The word chirality is derived from the Greek χειρ (cheir), the hand, the most familiar chiral object; the word enantiomorphs stems from the Greek εναντιος (enantios) 'opposite' and μορφη (morphe) 'form'. A non-chiral figure is called achiral or amphichiral.

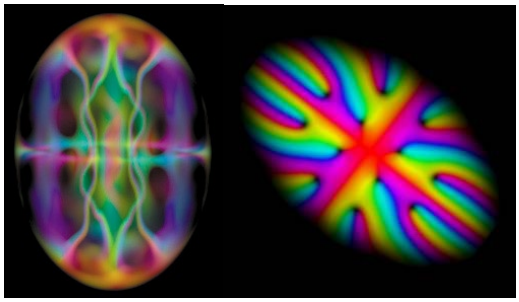


Figure 251. Emergence of vortex structure in a rotating Bose-Einstein condensate. From NIST Technology at a Glance, Fall 1999 Followed by Twelve-vortex array in a rotating Bose-Einstein condensate. (JILA). Credit: courtesy of JILA

John Talbot (creator of the laser stars website @ the National Astronomical Observatory in Canada) stated that; "Bose-Einstein Condensation (BEC) were Discovered in space! According to quantum mechanics atoms have wave-like properties and a corresponding de Broglie wavelength. Recent laser trapping and cooling experiments have succeeded in slowing atoms to such small velocity spreads that their wavelength corresponds to the average interparticle separation. If the atom behaves like a boson, the wave functions of all the atoms in the condensate collapse into a macroscopic quantum state consisting of a superposition of identical wave functions. This 'fifth' state of matter has coherence properties similar to laser light which can also be considered as a condensate of particles called photons. Lasers have been discovered in stellar atmospheres, hence there are naturally occurring BECs in outer space![72] The Nobel Prizes for 1997, 2001 and 2005 were awarded to scientist working with Lasers on the Bose-Einstein condensate which is the coherent unified state of matter in its ultimate quantum form. But above all through these findings we will acquire the proper understanding of Einstein's law of the coherent wave structure of matter, energy and information (appendix 1). This Law of life was derived from Einstein's Laser Informed Vision of the space/time continuum.

Through this book we have shown how Einstein's laser conception of 1916 became our living perception of the Laser Information Age. Thanks to the VRD (coherent visualization system) and its coupling to the IBM OpenDX software platform (Appendix 2) we now have the multidimensional graphics capabilities to re-create Einstein's equation of the universe with the vector potential and the scalar quantum wave (Appendix 1) formulas and integrate them into the visual action potential of our brains. Perhaps the most important application of the vector potential and the scalar quantum wave is in the search for the unified field equations (the coherent unification of the electro-magnetic, strong, weak and gravitation forces) between the General theory of Relativity and Quantum theory. We also saw how with Drucker's effective executive action program we can self-reflectively cultivate a connected or practical sense that eliminates the knowing-doing gap and thereby become a Universally Educated Person. And finally with Chomsky's libertarian socialism, MIT OCW and UNESCO's Virtual University we will liberate our laser information technology from the corporate or state capitalist monopoly. This will unlock the full spectrum knowledge potential of the human visual cortex and empower humanity to live free in the Open Resource Based Economy.

Appendix 1: VRD for Visualization of the Wave Structure of Matter

The Derivation of a Unified Field Theory from a Model of Spherical Quantum Waves by Michael Harney

Abstract: It is shown that if space is modeled as an elastic medium that propagates spherical, scalar quantum-waves, then the ratio of the square of the wave velocity to c2 reveals the same results as the familiar time dilation formula that is produced from the Schwarzschild G44 component. The Schwarzschild radius derived from the scalar-wave model is shown to be equal to the radius of the universe, implying that there are no gravitational singularities present within the radius of the universe. The spherical wave model also produces a formula that calculates the mass of a vector particle associated with each of the four forces and its associated range. [73]

http://www.spaceandmotion.com/science-physics-wsm-wave-diagrams.htm. Site Introduction (May 2008): Despite several thousand years of failure to correctly understand physical reality (hence the current postmodern view that this is impossible) it is actually very simple to work out how matter exists and moves about in Space. We just had to take Science (Occam's Razor / Simplicity) and Metaphysics (Dynamic Unity of Reality) seriously and thus describe reality from only one substance existing, as Leibniz wrote; Reality cannot be found except in One single source, because of the interconnection of all things with one another. When we deduce this most Simple Science Theory of Reality we find that there is only one possible solution: **Space must be the substance which exists and matter is formed from waves in Space**. i.e. While there are many minds and material things, they all exist in one common Space (just look around you and think about it). We can then show that the Wave Structure of Matter is the correct solution as it deduces the fundamentals of Physics & Philosophy perfectly (there are no opinions).
I realize that there are a lot of 'crackpot' theories about truth and reality on the internet, but this solution is the most simple one and it is obvious once known (though it takes time for our minds to adjust to new knowledge).
In hindsight the error was obvious - to try and describe an interconnected reality from the foundation of many discrete and separate things, matter 'particles', which then required forces / fields to connect them in space and time. This was always just a mathematical solution which never explained how matter was connected across the universe.

For those who are religious / spiritual, Space is really just another word for God (Brahman, Tao, Spirit, Energy, Light). What is certain is that discrete and separate 'particles' do not exist - we are all connected to this space that we all commonly experience. This underlying unity of reality (God) is central to all major world religions, thus their common moral foundation of 'Do unto others as to thyself' as the other is part of the self (we are all one with god / physical reality). Clearly there is still much to explain about our minds, our human emotions and moral / spiritual sense. This is no doubt the future of theology and our understanding of 'God', to explore the properties of this Space we all find ourselves existing in.

Please help our world (human society / life on earth) by sharing this knowledge.
Clearly our world is in great trouble, heading rapidly towards self destruction due to human overpopulation and the resultant destruction of Nature, climate change and the pollution of air, land and water (over 80,000 manmade chemicals contaminating everything we consume).
The best solution to these problems is to found our societies on truth and reality rather than past myths and customs (which invariably cause harm, our past and present global conflicts confirm this).
I am not naive to the difficulties that humanity faces. But history shows that truth eventually triumphs, that there are enough sensible logical people in the world who appreciate the importance of truth. We are listed as one of the Top Philosophy Websites on the Internet with around 500,000 page views each week, and rank in the top 20 in Google for many academic search terms - so we just need a bit of help to get in the top five (our aim). Given the Censorship in Physics / Philosophy of Science Journals (founded on the standard model / particle physics) the internet is clearly the best way to get new knowledge visible to the world. A world now in great need of wisdom from truth and reality.
Sincerely,
Geoff Haselhurst - Karene Howie - Read the Full Introduction - Email - Nice letters we receive - Share this Knowledge

In a time of universal deceit - telling the truth is a revolutionary act. (George Orwell)
You must be the change you wish to see in the world. (Mohandas Gandhi)
All that is necessary for evil to succeed is for good men to do nothing. (Edmund Burke)
Hell is Truth Seen Too Late. (Thomas Hobbes)

Wave Diagrams: The Wave Structure of Matter

Hi Everyone.
I have spent a bit of time over the past month working on these wave diagrams. I think this page is now actually very useful for visualizing the Wave Structure of Matter (WSM) and how matter exists and moves about in Space. It also provides simple sensible solutions to a lot of the problems of physics caused by the discrete 'particle' conception of matter in space-time.

The comments and diagrams below relate to the most simple form of matter, the electron or positron (antimatter is just the opposite phase standing wave to matter - which is why they annihilate due to destructive interference).
The proton and neutron are more complex wave structures that need further study (I think they are formed from a collection of positrons and electrons which form a neutral positronium - but a proton has one more positron than electron obviously to explain positive charge).

Please also realize that we are representing **spherical waves** in Space (imagine a soap bubble). These diagrams are 2 dimensional circular cross sections of the spherical wave (a limitation of working on a flat computer screen!).

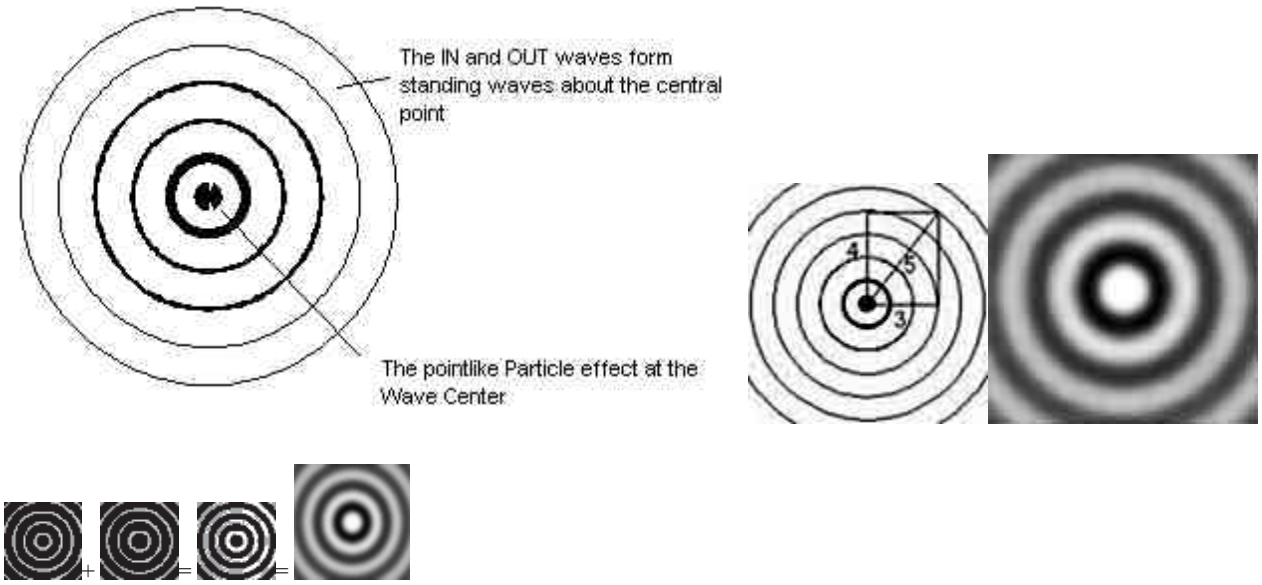
I hope this page helps you better visualize the wave structure of matter. It takes time for our minds to adjust to new knowledge, so you need to think about it for a while! But it is simple and obvious once known.

Any thoughts / comments help with wave diagrams appreciated.
Geoff Haselhurst - Email (Updated June, 2007)

Spherical Standing Wave (Two Dimensional Cross Section)

The wavelength of an electron is about 10-15 meters, i.e. there are about a million billion waves per meter, about a million (trillion) wave center 'particles' in a pin head.

The frequency is about 1021 Hz (cycles / second) so they are vibrating very very quickly!! Given film shown in a movie theater is around 24 frames / second and appear as continuous motion, you then realise why we see matter as a continuous motion as well.

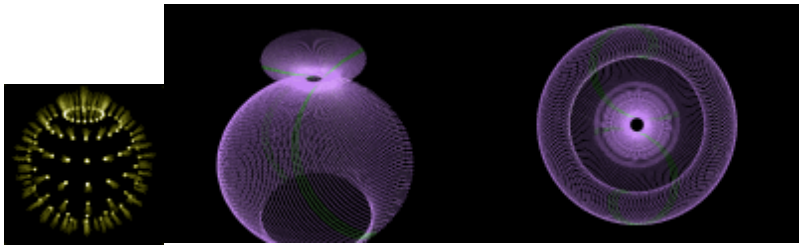


Appendix1.1 This very rough! diagram shows how the In-Waves and Out-Waves form a Standing Wave around the Wave-Center 'particle'.

The wave velocity is the velocity of light c (300 million meters / sec) which equates to 1 second for your spherical in-waves to come in from the distance of the moon, about 8 minutes from the sun, 4 years from the nearest star, 100,000 years from across our milky Way galaxy, and about 15 billion years from across the observable universe.

Though we always measure this velocity to be the same (Einstein's special relativity) it does actually change - but so does the wavelength and thus the dimension which causes it to be measured the same (Nature is deceptive!)!
The wave velocity depends on wave amplitude (higher = faster) - this explains charge.
The wave velocity also slows slightly with higher space energy density (more matter waves in space, calculated by squaring the wave amplitude). This is the cause of gravity and why light curves past the sun. (See light, charge and gravity diagrams below.)

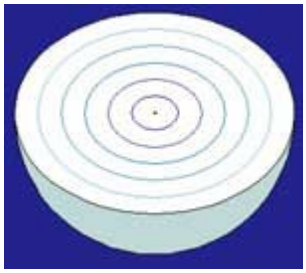
Spherical Standing Wave (Three Dimensional / Spherical Effect)



Appendix1.2 These images show some interesting ways to get a spherical effects (though not really relevant to WSM)

Below are some of my rough attempts from about 5 years ago (2002) to create a spherical effect, and show a series of spherical waves moving in to Wave-Center. (Flash movies)

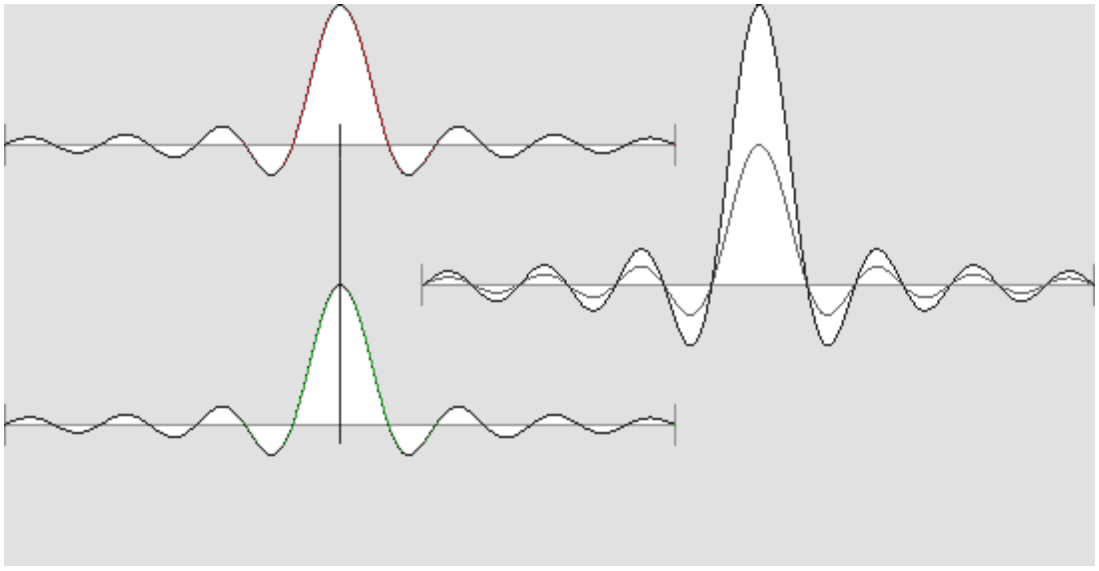
And recently a very nice member of our forum, Bill Back, sent me this image which shows the spherical shape of the waves a bit better.



Appendix1.3

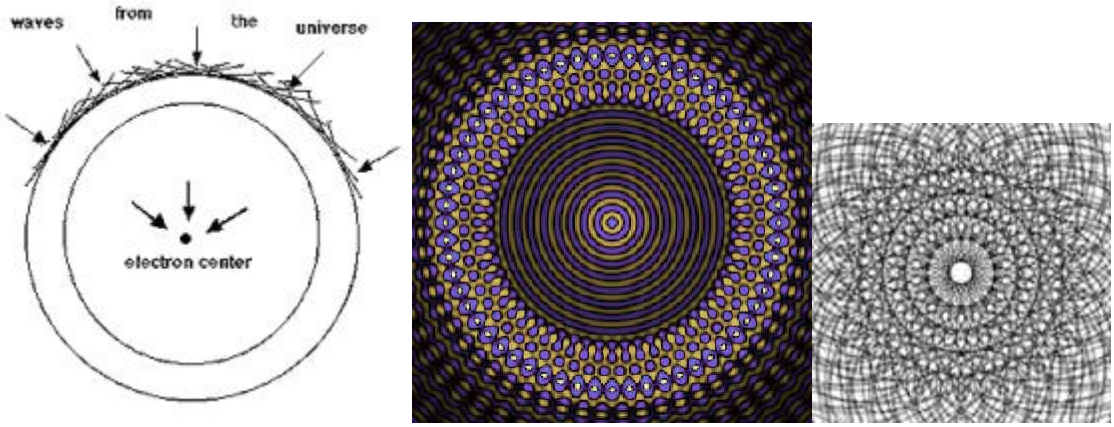
Formation of Standing Waves - Representing Waves as Transverse

Like water waves, waves on a string - bit misleading compared to real waves in space



Appendix1.4

Below are some stationary images of the electron wave center ‘particle’.



Appendix1.5

Non Linear Wave Interactions, Formation of Coherent In-Waves

Appendix1.6

The above diagram represents a wave in a linear wave medium - thus the waves maintain their original velocity even as they flow through one another.

However, Space must be a non-linear Wave Medium to explain wave interactions. I think this means that when the above two waves flow through one another, they get stuck together as one wave with combined wave amplitude and a higher velocity (i.e. Property of Space that waves with higher wave amplitude have higher velocity.) This is very important, as it is the source of all wave interactions, the cause of all forces, and explains how our In-Waves can form in a coherent way from other matter's out waves in the universe around us.

The Motion of the Wave-Center 'Particle'

For a moving wave center 'particle' the spherical in-wave forms in one position in space (as waves combine), then disappears (as waves cancel) then the next spherical in-wave forms in a slightly different position, and so on ....
So matter really moves in discrete little steps (like frames of a film) but it appears continuous due to the high 'frame rate' / frequency. This is what quantum theory discovered - but never understood! The gravity image below shows this effect.

Some Ideas for Better Wave Diagrams!

It would be nice if a few people with talent for creating wave diagrams could share their ideas and skills to create a variety of wave diagrams.

• 1. The electron - spherical and cross section, showing in and out waves forming a spherical standing wave.

• 2. Charge - Waves are non-linear and travel faster with higher wave amplitude. Thus you can show that for two electrons that are in phase, then they're in and out waves between them have a higher wave amplitude, travel faster, and thus cause wave centers to reposition further apart over time (like charges repel). For an electron and a positron the opposite is true, the positron (antimatter) is just an opposite phase standing wave to the electron, so the waves between them cancel, have lower wave amplitude, and travel more slowly causing wave centers to form closer together.

• 3. Light - need to take into account high velocity de Broglie phase wave that determines allowed wave function / pattern of electron in atom / molecule - while also showing how two electrons in different atoms / molecules can resonantly couple and change their respective wave patterns (emit and absorb discrete amount of energy / photon of light).

• 4. Gravity - slowing of in-waves causing them to change ellipsoidal shape (Einstein's curvature of 4D space-time) and which also changes location of wave center over time (with each successive in-wave the wave center repositions itself in the direction of slowest incoming spherical waves - and waves travel slower where there is more matter / higher wave energy density of space). We are currently working on this at the moment (will add stuff here once complete) - looking at how light curves as it passes the sun to calculate how the mass of the sun compared to the average mass of the universe slows the wave velocity.

• 5. EPR / Non Locality - de Broglie phase wave where velocity is c^2 / relative velocity, so very fast at low relative velocities, to explain faster than light (non local) interactions.

• 6. Cosmology - Huygens' principle and the formation of in-waves from the out waves of all other matter in a finite spherical region of space (our observable universe) within infinite space.

Anything else that you think would be useful??!!

Cheers,
Geoff Haselhurst
Email

Physics Websites on Waves / Wave Diagrams

I went through my physics favorites and picked out a few websites that have wave diagrams, stuff on wave mechanics. I am sure there is a lot more out there - so if you find any good information / diagrams please email us.
Geoff

http://www.spaceandmotion.com/Physics-LaFreniere-Wave-Diagrams.htm - Gabriel LaFreniere has also deduced that matter is a wave structure of space. He has done this using wave diagrams, the work is very impressive!
http://www.glafreniere.com/matter.htm

http://www.ryanhagan.net/mike/StandingWave3D/StandingWave3D.htm - Created by Mike Weber. Please realize that these diagrams are transverse waves (like waves on water) used to represent real 3D Spherical Waves. Mike is in our small WSM discussion group and we have high hopes that over time he will do some incredible work to help us visualize matter's wave structure and interactions.

http://www.walter-fendt.de/ph11e/index.html - Lots of physics Java applets (animated diagrams) including wave diagrams.

http://www.du.edu/~jcalvert/waves/wavhom.htm#index - Very good physics site on various wave phenomena with math physics explanations / calculations.

http://www.mathpages.com/home/kmath242/kmath242.htm - Very good article on Huygens' Principle. This is important to the Wave Structure of Matter as it explains how the spherical Out-Waves of all other matter in our finite spherical universe form into the In-Waves of our matter (which explains both source of In-Waves and Mach's Principle (mass of body is determined by all other matter in universe).

http://www.colorado.edu/physics/2000/quantumzone/debroglie.html - A bit daggy, but provides simple explanation of particle wave duality. If they just realized that particle effects are due to discrete standing wave interactions it would be so sensible and obvious instead of strange and paradoxical. Worth clicking through their pages though.

http://g2pc1.bu.edu/~roberts/py231/exam94_sol.pdf - Music and waves

http://www.falstad.com/ripple/ - Very impressive site with good variety of Java Applets of Wave Diagrams.
http://www.falstad.com/mathphysics.html

http://ccrma.stanford.edu/~jos/pasp/Spherical_Waves_Point_Source.html

http://www.kettering.edu/~drussell/Demos/waves/wavemotion.html

http://oolong.co.uk/resonata.htm - I just found Fergus Ray-Murray's website (June 2007). Some wonderful animations and very good knowledge of waves / resonance.

http://science.uniserve.edu.au/school/curric/stage6/phys/physapplets.html - Very good collection of Physics Java applets.

Appendix 2. VRD for OpenDX

Jump to Wikipedia: navigation, search

Appendix2.1 OpenDX gives you new control over your data...and new insights into their meaning. Yet OpenDX is easy to use because it lets you visualize data in ways you've never dreamed of--without getting bogged down in the technology. As its name implies, OpenDX is Open Source. The license allows you to freely create, distribute, and develop visualization solutions as you see fit. OpenDX is a uniquely powerful, full-featured software package for the visualization of scientific, engineering and analytical data: Its open system design is built on standard interface environments. And its sophisticated data model provides users with great flexibility in creating visualizations. With OpenDX, you can create the visualizations you want to create. OpenDX has been designed to be the place where the art of science and the science of visualization come together. It's the place where they're combined into one powerful, flexible framework that lets you "Simply Visualize.[74]" IBM OpenDX logo. Credit: courtesy of Wikipedia

OpenDX stands for Open Data Explorer and is IBM's scientific data visualization software. It can handle complex domains (as the mechanical gear or a human brain) along with measured or computed data. The data may be scalar (such as the concentration of a chemical agent in the brain), vector or tensor fields (like the displacement or strain tensor fields when the gear is in action) at different points of the object. The points at which data is measured don't have to be equally spaced, and not need to be homogeneously spaced. The project started in 1991 as Visualization Data Explorer.

OpenDX can do 3D visualizations and represent the measured quantities color or gray scale coded, or as vectors, streamlines and ribbons. It can make cuts in the object to have a view of the inside, and then represent the data on this cutting plane as a height coded graph. It can rotate the object to have a view of the data from any angle, and make animations of these movements.[75]

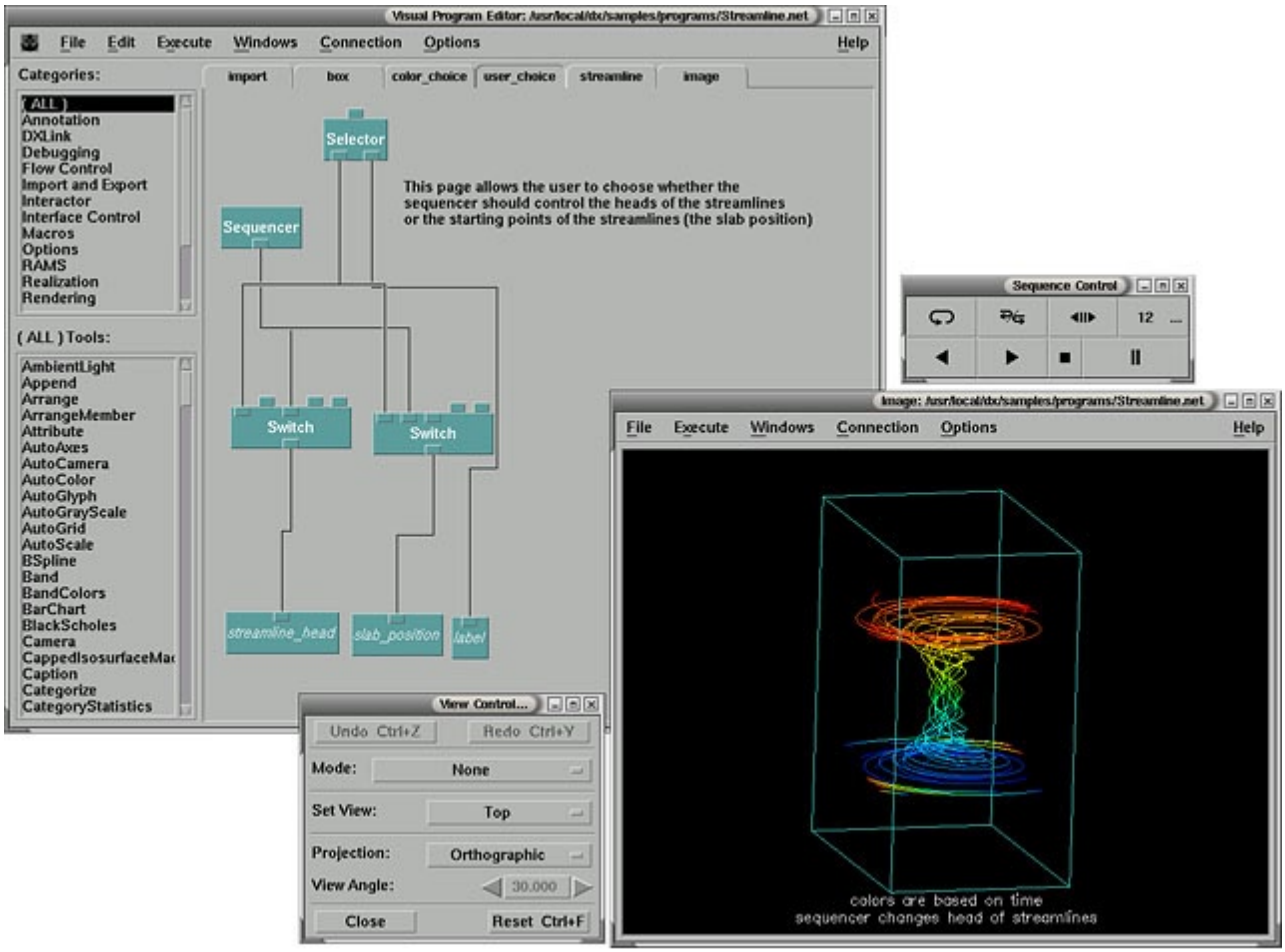
Contents

[hide]

- 1 Graphical User Interface
- 2 Design
- 3 Screen shots
  - 3.1 Visualization of a scalar field
  - 3.2 Visualization of vector fields
- 4 External links

Graphical User Interface

OpenDX is based on the Motif widget toolkit on top of the X Window System. Its graphical user interface has a wide variety of interactors, both direct and indirect. Direct interactors allow the user to directly manipulate images (e.g. rotate or zoom). Indirect interactors (dials, switches, buttons, sliders) enable the user to control various aspects of her visualization. Interactors are smarter because they are data-driven. Interactors are auto-ranging and self-limiting. They examine the data and, depending on its type, will determine the minimum and maximum of the data, or create a list for an option menu based on the data. The user can even set the label of the interactor based on some aspect of the data (e.g., metadata).



Appendix2.2

OpenDX screen shot showing the Visual Program Editor and several interactors

The data-driven concept is not simply for sliders, dials and option menus. It also applies to vector interactors. These will reconfigure themselves based on the dimensionality of the data. They will also auto-range themselves based on the maximum and minimum of each vector component.

Design

Data Explorer is a system of tools and user interfaces for visualizing data. In general terms the visualization of data can be considered a 3-stage process:

- Describing and importing data
- Processing the data through a visualization program
- Presenting the resulting image.

The principal components of OpenDX are

Data model

This is the set of definitions, rules, and conventions used to describe Data Explorer entities (including data fields, geometrical objects, and images).

Data Prompter

A user interface for describing data to be imported into Data Explorer.

Data Browser

A user interface for viewing a data file, determining the layout and organization of the data it contains, and transferring this information to the Data Prompter.

Scripting Language

A high-level language for creating visualization programs. It can also be used directly in a command mode to perform various tasks. Visual programs--i.e., the visualization programs displayed in the Visual Program Editor window as networks of module icons--are also written in the scripting language. A visual program constructed in this window by the user is translated into the same language when it is saved to disk.

Visual Program Editor (VPE)

A graphical user interface for creating and modifying visual programs (networks). Programs created with this editor are translated into the scripting language by Data Explorer and are stored in that form.

Modules

The building blocks (visualization tools) that constitute a visual program network. They can be directly accessed and manipulated in the Visual Program Editor.

Module Builder

A user interface for creating customized modules to be used in visual programs.

Image Window

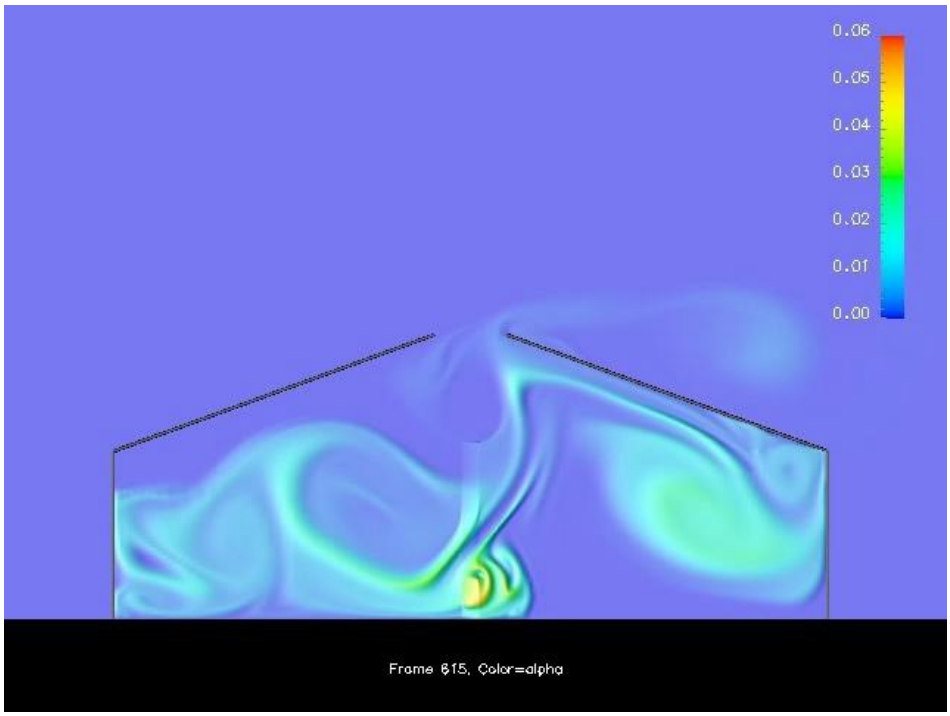
An interactive window for viewing and modifying the presentation of the image produced by a visual program.

Control Panels

A user interface for changing the parameter values used by a visual program.

Screen shots

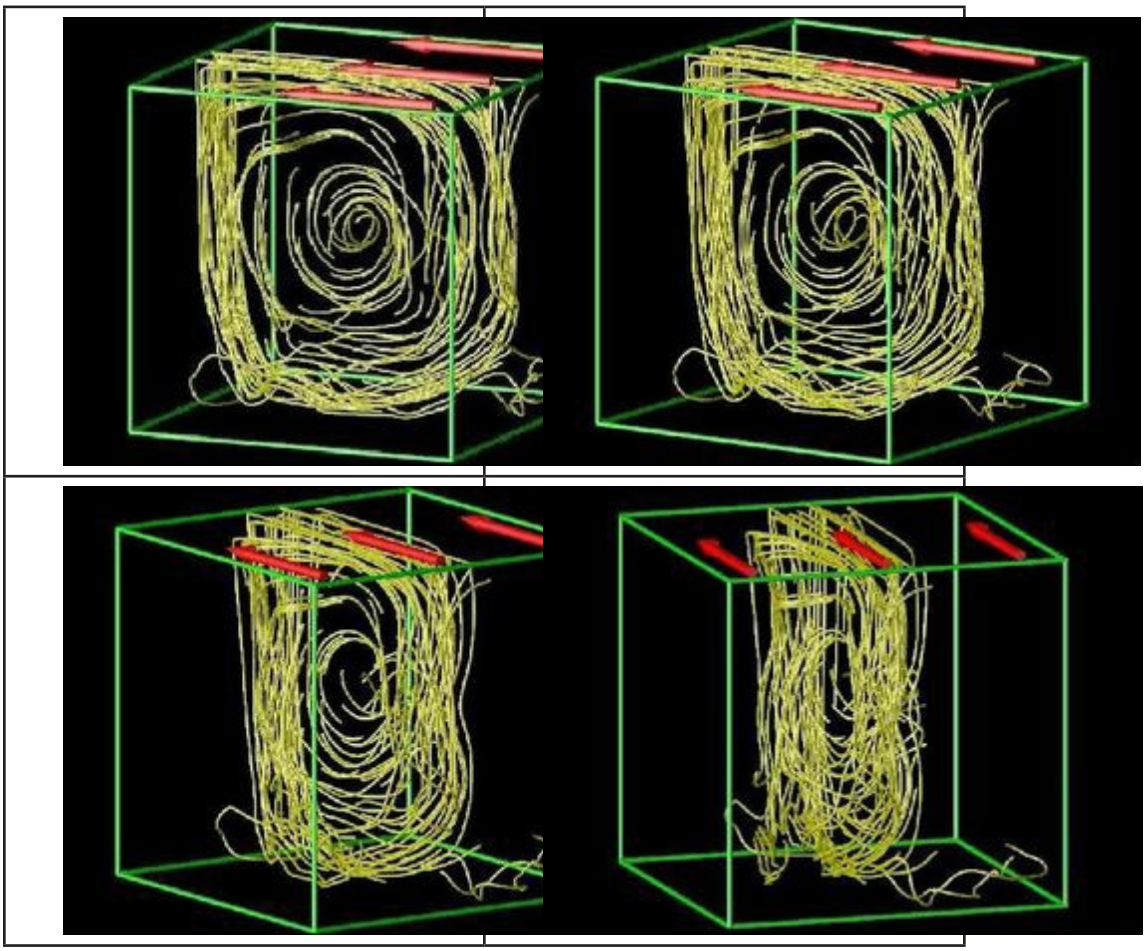
Visualization of a scalar field



Appendix2.3 OpenDX screen-shot showing visualization of a scalar field.

In this example we show the visualization of the flow of a particulated material (dust) inside a building. In this case the quantity visualized is a scalar, namely the concentration of the particles. The concentration of particles at each point in space is represented using colors. The reader can deduce the concentration by comparing the colors with the colorbar at the right upper corner of the image. To improve the visualization the drawing is shadowed as if it had an elevation in the direction normal to the plane proportional to the concentration. In OpenDX this is called the rubber-sheet effect.

Visualization of vector fields



Appendix2.4.Vector fields are harder to visualize than scalar ones. Consider in this case the flow in a cubic cavity (the 3D version of the well studied square cavity benchmark. The use of streamlines helps in realizing the direction of the flow. The rockets (the big red arrows on the top of the cavity) represent the imposed flow.[76]

Appendix 3. VRD for MITOCW/Quantum Relativity studies.

Learning QR is intimidating, first because to do it properly, you need some serious mathematics in your back pocket. Just consider the following essential mathematical skills: (roughly in order)

BASIC SKILLS
Basic Geometry & Algebra (areas volumes)
Cartesian Coordinate Spaces (dimensions, orthogonal scales)
Trigonometry (projective geometry, transforms)
Probability Theory
Elementary Calculus (single variable, real numbers)
Complex Number Theory (imaginary number spaces)
Vector Algebra (phasors)
Fourier Analysis (harmonic structures, pulses & transients)
Ordinary and Partial Differential Equations. (along with Newtonian Mechanics)
Laplace Transforms and Lebesque Integrals (very good but difficult)

This gets you as far as Electrical Engineer...then:

Advanced Math:
Non-Euclidean Geometry (Minkowski Spaces)
Special Relativity (needed for accuracy in predictions & corrections)
Tensors and Fields (for Gen Rel & Advanced Electrodynamics)
Matrix Algebra (core parts of Quantum Mechanics)
Wave Theory (from Maxwell to Schrödinger)
Matrix Calculus (Eigen Values and Eigen Matrixes)
Hilbert Spaces
Group Theory (critically important)

Abstract thinking skills involving questioning of philosophical foundations, hidden assumptions, axioms, definitions & weaknesses,

On the side you should be studying some chemistry, and physics topics like:
thermodynamics, spectroscopy, nuclear structure, magnetism, superconductivity, particle accelerators, Big Bang cosmology, quarks, tachyons.

Historically you should bone up on: the 2nd Law of Thermodynamics, the evolution of gravitational theories, the mystery of 'Spin', the ether, relativity and Machian Mechanics. the Discovery of quantum effects, Light. The Interpretation of Quantum Formalisms - Bell's Inequality, EPR experiments.

On the physics / experimental side, learning QM requires serious 'accuracy'/tidy skills, for experimental results to be meaningful and reliable. Good comprehension of mechanics and building skills.
Ability to calculate strength, stress, force, flexibility etc. for success and calibration.

Resources
To get all this you have to have access to dozens of books, not just a single QM textbook. and the usual situation in University is that you take a variety of other critical courses in math and physics alongside QM to provide what cannot be provided by the QM course itself. This is the flaw with QM books, and even huge QM 'bibles'. You need a whole textbook on each mathematical specialty!

Environment
For instance, try your hand at electrical engineering first: if you can handle the mathematics behind that, such as sinusoidal analysis, electromagnetic theory, you are almost ready to try tackling QM! But you will still need a few years of preparation on such topics as Group Theory and Riemannian Manifolds!

Key Texts in my view would be: Collective Electrodynamics by Carver Mead (continuing Feynman's program)

Transactional Interpretation of QM by John Cramer
(continuing from: Einstein EPR, Bell, Bohm, Stapp..with experimental support!)

Then you can ignore outdated interpretations like Copenhagen,
and idiotic interpretations like Many Worlds.[77]

Appendix 4. VRD Safety Considerations

Viirre, E.S., Johnston, R.S., Pryor, H.L. and Nagata, S. (1997). Laser Safety Analysis Of A Scanned Light Display. Investigative Ophthalmology & Visual Science, Abstract Book - Part II, A38(4), 4706-B213, S1011.

Laser Safety Analysis Of A Scanned Light Display ((E. S.Viirre, R. S. Johnston, H. L. Pryor and S. Nagata)) Human Interface Technology Laboratory, Box 352142, University of Washington, Seattle WA 98195-2142

Purpose. The Virtual Retinal Display (VRD) is a new visual display device that uses laser light scanned directly onto the retina to create images. Unlike other scanning technologies, the VRD uses a scanner less than one cubic centimeter in volume which operates at greater than 12 kHz. This high frequency gives the ability to produce high resolution images. We expect that the VRD will become a ubiquitous display source for normally sighted and partially sighted viewers. Our research goals include understanding of spatial and temporal integration of light energy scanned into the eye and image perception. We first wanted to determine the safety limits on power output of the device. Images from the VRD are bright, high contrast and yet are produced with laser power outputs on the order of 100 to 300 nanowatts. A prototype color VRD produces VGA images (640 78 480) with a 30 79 40 degree field of view. The color sources are: red diode laser at 650 nm, green helium neon at 543.5 nm and blue argon at 488 nm. Methods. The American National Standards Institute (ANSI) publishes the standards (Z136.1, 1993) that govern laser safety. Because the ANSI standard does not explicitly cover intrabeam viewing of a scanned source, we performed several different methods of safety analysis. The standard approach to safety analysis is to calculate the Maximal Permissible Exposure (MPE) for the aperture of the eye. Conservative estimates are used to determine MPE, including assuming light of wavelengths 400-550 nm (the most hazardous) and assuming a continuous 8 hour exposure.

Results: Our analysis for a pulsed laser results in an MPE of 160 milliwatts, which is 5 to 6 orders of magnitude above the output of the VRD. Analyzing the VRD as a continuous wave laser source gives similar values to pulsed laser calculations. If the VRD is considered an extended laser source because of its scanning nature, the MPE reduces to 150 microwatts which is 2-3 orders of magnitude above typical operating power. Failure analysis indicates that the VRD is safe at the typical power levels, even if the scanners were to fail completely and the source was to remain on.

Conclusion: At typical operating power outputs, the VRD is a safe laser based display device. □

Glossary for LaserFusionPower

Ablate – To remove material from the surface of an object by vaporization, chipping, or other erosive processes. Laser ablation is a process in which the molecular bonds of a material are dissolved by a laser.

Alpha Particle – The nucleus of a helium-4 atom, consisting of two protons and two neutrons. A deuterium-tritium fusion reaction, in which the nuclei of two hydrogen isotopes fuse, produces an alpha particle and a free neutron.

Astrophysics – The branch of physics that deals with the universe, including the physical properties (luminosity, density, temperature and chemical composition) and the interactions of astronomical objects such as stars, galaxies and the interstellar medium. It also includes studies of the nuclear reactions that power stars, and uses the abundances of the elements to understand the internal processes of stars.

Blowoff – The rocket-like expulsion of hot material from the surface of an object, such as an ignition target, which causes the object to implode, or compress rapidly, just as the expulsion of hot gas from a jet engine propels an aircraft.

Breakeven – In fusion, scientific breakeven occurs when the fusion power is equal to the laser input power (see Ignition). Commercial breakeven is when sufficient fusion power can be converted into electric power to cover the costs of the fusion power plant at economically competitive rates (see Inertial Fusion Energy).

Burn – See Thermonuclear Burn.

Direct-Drive Ignition – An approach to inertial confinement fusion in which laser or particle beam energy is directly focused on a fusion fuel capsule, uniformly illuminating the capsule from all directions and resulting in compression heating from the ablation of the target surface (see Ignition). Compare with
Indirect-Drive Ignition.

D-T Fuel – A mixture of the hydrogen isotopes deuterium and tritium. When sufficiently heated and compressed in a fuel capsule, the nuclei of the atoms fuse, producing an alpha particle and a free neutron.

Deuterium – A heavy isotope of hydrogen, with one neutron and one proton in the nucleus.

Electron – A subatomic particle with negative electric charge that lies outside the nucleus of an atom.

Energy – The capacity of a physical system to do work; the units of energy are joules.

Frequency – The number of complete oscillations of an object in a given period of time (see Wavelength).

Fuel Capsule – A hollow spherical capsule about the size of a BB containing D-T Fuel. NIF will use capsules having outer shells made of beryllium, carbon or carbon-hydrogen polymers. For inertial fusion energy, the shell is filled with a mixture of deuterium and tritium. The fuel capsule must be cold enough for the D-T fuel to freeze and form a layer of D-T ice on the inner wall of the capsule.

Fluence – The amount of laser energy passing through a given area, typically expressed in joules per square centimeter (see Irradiance).

Fusion – A nuclear reaction in which nuclei combine to form more massive nuclei with the simultaneous release of enormous amounts of energy.

High Energy Density Physics – The field of physics concerned with the properties and interactions of materials with energy densities exceeding 10^{11} joules per cubic meter, or equivalently, pressures exceeding one megabar (one million Earth atmospheres).

Hohlraum – German for “hollow space,” a hohlraum is a hollow metal cylinder the size of a pencil eraser surrounding a fusion fuel capsule. In radiation thermodynamics, a hohlraum is defined as “a cavity whose walls are in radiative equilibrium with the radiant energy within the cavity.” The hohlraum converts directed energy from either laser light or particle beams into X-ray radiation. The use of X-ray indirect radiation rather than laser light direct radiation provides additional options for compressing and heating the fuel capsule, or target, under the required conditions of Inertial Confinement Fusion (see Indirect-Drive Ignition).

Ignition – In laser fusion, ignition is defined as energy output equal to or greater than the amount of laser energy incident on the target assembly (for indirect drive, the target assembly consists of the hohlraum and fuel capsule; for direct drive, it consists of the capsule). As in an ordinary (chemical) fire, ignition is the point at which the temperature and confinement of heat in the fuel (plasma in the case of fusion) are such that energy released from ongoing reactions is sufficient to maintain the temperature of the system and no external heating is needed. An ignited fusion plasma produces so much energy from fusion reactions that the plasma is fully heated by the fusion reaction products (alpha particles in the case of deuterium-tritium fusion).

Implode – Explode inward. The NIF fuel capsule will implode at a speed of up to 300 kilometers a second.

Inertial Confinement Fusion – The approach to fusion in which a fuel capsule is imploded very quickly, so that the inertia of the converging fuel ions allows fusion to occur before the particles can disperse.

Indirect-Drive Ignition – An approach to inertial confinement fusion in which the inner surface of a hohlraum containing a fuel capsule is illuminated by laser beams entering through holes at its end caps. The laser energy is converted to X-rays, which heat and ablate the capsule surface, causing a rocketlike pressure on the capsule and forcing it to implode (see Ignition). Compare with Direct-Drive Ignition.

Inertial Fusion Energy – In inertial fusion energy (IFE), a "driver" focuses beams of accelerated ions or intense laser light on a "target" filled with hydrogen fuel. An IFE power plant would have separate areas for the driver, a factory for making the targets, a target chamber where the fusion reactions occur, and a steam turbine to generate electricity. The driver must ignite several fusion targets per second to produce the desired power level in the chamber (see Ignition).

Ion – An atom or molecule that has acquired an electrical charge by the loss or gain of electrons.

Irradiance – The amount of light energy incident on a given area of surface in a given amount of time, measured in Watts per square meter (see Fluence).

Isotope – Different forms of atoms of the same element. Isotopes have the same number of protons in their nuclei but a different number of neutrons (the same atomic number but different atomic weights). Uranium-238 and uranium-235 are isotopes of uranium. Isotopes may be stable (not spontaneously decaying) or unstable (spontaneously decaying, emitting ionizing radiation).

Joule – A unit of energy. One joule is the energy required to lift a small apple one meter against the Earth's gravity.

KDP Crystal – A potassium-dihydrogen-phosphate (KDP) crystal is a transparent dielectric material used in large-aperture laser systems such as NIF to change the frequency, or color, and the polarization of the laser light. KDP crystals are used at NIF because they can be grown as a single crystal to large size.

Laser – An acronym for light amplification by stimulated emission of radiation. If the electrons in special atoms in glasses, crystals or gases are energized into excited atomic states, they will emit light photons in response to a weak laser pulse. The photons will all be at the same wavelength and will also be "coherent," meaning the light wave's crests and troughs are all in lockstep. In contrast, ordinary visible light comes in multiple wavelengths and is not coherent.

Laser Fusion – A form of inertial confinement fusion in which laser beams are used to compress and heat a fuel capsule.

Main Laser – The portion of the NIF beampath in which the nominal one-omega, or infrared, laser light is generated, amplified and transported to the target chamber (see Wavelength).

Magnetic Confinement Fusion – An approach to fusion energy in which magnetic fields confine a plasma which is heated until fusion occurs.

Neutron – A subatomic particle with no charge located in the nucleus of an atom.

Nucleus – The positively charged dense core of an atom, containing protons and neutrons.

Omega – The last letter of the Greek alphabet, omega is the symbol used by physicists to denote frequency. The optics in NIF's main laser produce laser light in the infrared portion of the electromagnetic spectrum, which is designated one-omega (1ω). NIF's final optics double the light's frequency to visible green light (2ω) and finally to ultraviolet light (3ω). Ultraviolet light is more effective than infrared at compressing NIF's fuel capsule (see Wavelength).

Petawatt Laser – A laser capable of producing pulses with more than one quadrillion watts of peak power A Petawatt is 10^{15} watt.

Photon – A particle of light; a quantum (the smallest unit in which waves may be emitted or absorbed) of electromagnetic energy moving at the speed of light.

Plasma – Known as the "fourth state of matter," a plasma is a substance in which many of the atoms or molecules are effectively ionized, allowing charges to flow freely. Some 99 percent of the known universe is in the plasma state. Plasmas have unique physics compared to solids, liquids, and gases. Examples of plasmas include the sun, fluorescent light bulbs and other gas-discharge tubes, much of interplanetary, interstellar and intergalactic space, laser-produced plasmas and plasmas produced for magnetic confinement fusion.

Power – The amount of work done per unit of time (see Energy). At NIF, the production of 1.8 million joules of energy in a few billionths of a second is equivalent to 500 trillion watts of power.

Proton – A positively charged subatomic particle usually found in the nucleus of an atom.

Stockpile Stewardship Program – The maintenance of the U.S. weapons stockpile through an ongoing process of surveillance,

assessment, refurbishment and recertification, without nuclear testing.

Target – See Fuel Capsule.

Thermonuclear Burn – In a fusion reaction, burn is achieved by heating the fuel into the plasma state to the point where nuclei have sufficient energy to fuse when they collide, typically requiring temperatures of at least one million kelvins (1.8 million degrees Fahrenheit). Thermonuclear fusion converts a small amount of the mass of the reactants into energy via $E = mc^2$, and is the process by which most types of stars, including the sun, produce the energy to shine.

Tritium – An isotope of hydrogen that has two neutrons and one proton in the nucleus. Tritium is unstable, with a half-life of 12.32 years.

Wavelength – The distance between adjacent crests or troughs of a light wave, which determines its color. The optics in NIF's main laser produce infrared laser light with a wavelength of 1,053 nanometers (billionths of a meter), also known as one-omega (1ω). In NIF's final optical assembly, the infrared light is converted to visible green light (527nm, or 2ω) and then to ultraviolet light (351 nm, or 3ω) at the center of the target chamber (see Frequency).

(Endnotes)

1 John Lennon's song Beautiful Boy @ http://www.youtube.com/watch?v=CMCmoHAax10&NR=1.

2 For a global image of our visual system go to Google search @ http://images.google.com/images?q=visual+system&-sourceid=navclient-ff&rlz=1B2GGFB_enUS221&um=1&ie=UTF-8&ei=mwSQSeJdiqG3B7HSsJcL&sa=X&oi=image-result_group&resnum=4&ct=title. For a more in depth study go to MIT OCW: Home > Courses > Brain and Cognitive Sciences > The Visual System 9.036: The Visual System: Spring 2005

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4 EC/NSF Position Paper: Toward tightly-coupled human interfaces by Dr. Furness @ http://www.hitl.washington.edu/research/vrd/. See also, MIT OCW Readings for Home > Courses > Media Arts and Sciences > Ambient Intelligence. AUGMENTING HUMAN INTELLECT: A Conceptual Framework. http://sloan.stanford.edu/mousesite/EngelbartPapers/B5_F18_ConceptFrameworkInd.html. Permission for Microvision photos was granted with some conditions: From: Matt Nichols <matt_nichols@microvision.com> Sent: Oct 9, 2008 01:30:30 PM To: Carlos Concepcion <conceptus@verizon.net>Carlos, I have reviewed the context of the photo use and you are granted permission to use these for your self-published book, entitled Laser Information Age. As a number of these photo's are historical to Microvision and no-longer in circulation, note that photo permission is granted only for containment within the self-published book as you've defined. No publicity, promotional, or advertising use in any format are allowed using any of these images. Any further publishing rights of these photos beyond the self-publishing defined by you are not permitted. Regards, Matt Nichols Director of Communications, Microvision.

5 http://en.wikipedia.org/wiki/Classified_information..[2] http://en.wikipedia.org/wiki/Freedom_of_information. See: Blown to Bits: Your Life, Liberty, and Happiness After the Digital Explosion by Hal Abelson, Ken Ledeen, Harry Lewis and The Future of the Internet--And How to Stop It by Jonathan Zittrain

6 See a live interview with one of the authors @ http://www.democracynow.org/2009/2/12/harry_lewis_blown_to_bits_your.

7 The Bayh-Dole Act or University and Small Business Patent Procedures Act is a piece of United States legislation from 1980. Bayh-Dole is codified in 35 U.S.C. § 200-212[1], and is implemented by 37 C.F.R. 401[2]. Among other things, it gave US universities, small businesses and non-profits intellectual property control of their inventions that resulted from federal government-funded research. The act, sponsored by two senators, Birch Bayh of Indiana and Bob Dole of Kansas, was enacted by the United States Congress on December 12, 1980. http://en.wikipedia.org/wiki/Bayh-Dole_Act. http://www.cogr.edu/docs/Bayh_Dole.pdf.

8 Introduction to Ivory Tower and Industrial Innovation: University-Industry Technology Transfer Before and After the Bayh-Dole Act by David Mowery, Richard Nelson, Bhaven Sampat, Arvids Ziedonis. David C. Mowery is Milton W. Terrill Professor of Business at the Haas School of Business, University of California, Berkeley. Richard R. Nelson is George Blumenthal Professor of International and Public Affairs, Business and Law at Columbia University. Bhaven N. Sampat is Assistant Professor of Public Policy and Technology at the Georgia Institute of Technology. Arvids A. Ziedonis is Assistant Professor of Corporate Strategy and International Business at the University of Michigan. http://sciencecommons.org/resources/readingroom/

9 The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability (Hardcover) by Marco Iansiti (Author), Roy Levien. In biological ecosystems, "keystone" species maintain the healthy functioning of the entire system. Why? Because their own survival depends on it. This book argues that business ecosystems work in much the same way-one company's success depends on the success of its partners. Based on more than ten years of research and practical experience within industries from retail to automotive to software, The Keystone Advantage outlines a framework that goes beyond maximizing internal competencies to leveraging the collective competencies of one's entire network for competitive advantage. Marco Iansiti is the David Sarnoff Professor of Business Administration at Harvard Business School and cochair of Harvard's PhD Program in Information Technology and Management. Roy Levien is an Inventor at Intellectual Ventures, an intellectual property fund, and the Manager and Principal of Keystone Advantage LLC, a technology consultancy.

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16 Blown to Bits: Your Life, Liberty, and Happiness After the Digital Explosion (Hardcover) by Hal Abelson (Author), Ken Ledeen (Author), Harry Lewis (Author)

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22 http://ocw.mit.edu/OcwWeb/web/about/about/index.htm.

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36 Intelligence comes from the Latin verb "intellegere", which means "to understand". By this rationale, intelligence (as understanding) is arguably different from being "smart" (able to adapt to one's environment), or being "clever" (able to creatively adapt). http://en.wikipedia.org/wiki/Intelligence.

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50 http://video.google.com/videoplay?docid=-1656880303867390173.

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52 http://www.onpointradio.org/shows/2008/10/how-to-fix-the-economy/. http://en.wikipedia.org/wiki/Credit_default_swap.

53 Financialization and Its Discontents, May 5, 2008 by Izaak VanGaalen

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61 (1991, p101)

62 (1983)

63 (Daft,1983)

64 (1993, p35)

65 (Makadok, 2001, p388-389; Hoopes, Madsen and Walker, 2003, p890)

66 (Conner and Prahalad, 1996, p477; Makadok, 2001, p338; Barney, Wright and Ketchen, 2001, p630-31). http://en.wikipedia.org/wiki/Resource-Based_View. See also; The Role of Science and Technology Policies in Natural Resources Based Economies (Paperback) by Pablo Catalan. See the free report: The role of S&T policies in natural resources based economies: The cases of Chile and Finland Pablo Catalan School of Public Policy Georgia Institute of Technology @ http://www.cherry.gatech.edu/t2s2006/papers/catalan-1020-T.pdf.

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by Ivan Amato. From protons to parsecs, Ivan Amato's "Super Vision" reveals what many scientists know: the universe is a visually stunning place. This remarkable collection of images, coupled with Amato's compelling captions, shows the art that can be found in science. Thanks to advances in instruments ranging from atom smashers to telescopes, combined with unprecedented computer power, the phenomena of the cosmos can be painted in vivid color. Scientists use these images in their daily effort to understand the universe; we can enjoy them for pure aesthetic pleasure. Covering 42 orders of magnitude (powers of ten), "Super Vision" shows us the abstract swirls of a decaying particle, the eerie machinery of a spider's spinnerets, how zebra fish scales can look like a Balinese hillside, and the tortured faces of distant planets. For a guide to the art in our natural world, this is the book. It's as beautiful as the universe it describes. Review by David Voss (Silver Spring, MD USA).

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472 Sat, 2007-11-10 23:00 ? LaserGuy

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CourseHome/index.htm/ The central assumption of computational neuroscience is that the brain computes. What does that mean? Generally speaking, a computer is a dynamical system whose state variables encode information about the external world. In short, computation equals coding plus dynamics. Some neuroscientists study the way that information is encoded in neural activity and other dynamical variables of the brain. Others try to characterize how these dynamical variables evolve with time. The study of neural dynamics can be further subdivided into two separate strands. One tradition, exemplified by the work of Hodgkin and Huxley, focuses on the biophysics of single neurons. The other focuses on the dynamics of networks, concerning itself with phenomena that emerge from the interactions between neurons. Therefore computational neuroscience can be divided into three subspecialties: neural coding, biophysics of neurons, and neural networks.

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Part 3.9 How my Laser Informed Vision emerged from Einstein's Brilliant Idea of the Laser

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659 Metaphor (from the Greek language: μεταφορά - metaphora, meaning "transfer") is language that directly compares seemingly unrelated subjects. In the simplest case, this takes the form: "The [first subject] is a [second subject]." More generally, a metaphor is a rhetorical trope that describes a first subject as being or equal to a second object in some way. Thus, the first subject can be economically described because implicit and explicit attributes from the second subject are used to enhance the description of the first. This device is known for usage in literature, especially in poetry, where with few words, emotions and associations from one context are associated with objects and entities in a different context. http://en.wikipedia.org/wiki/Metaphorically.

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